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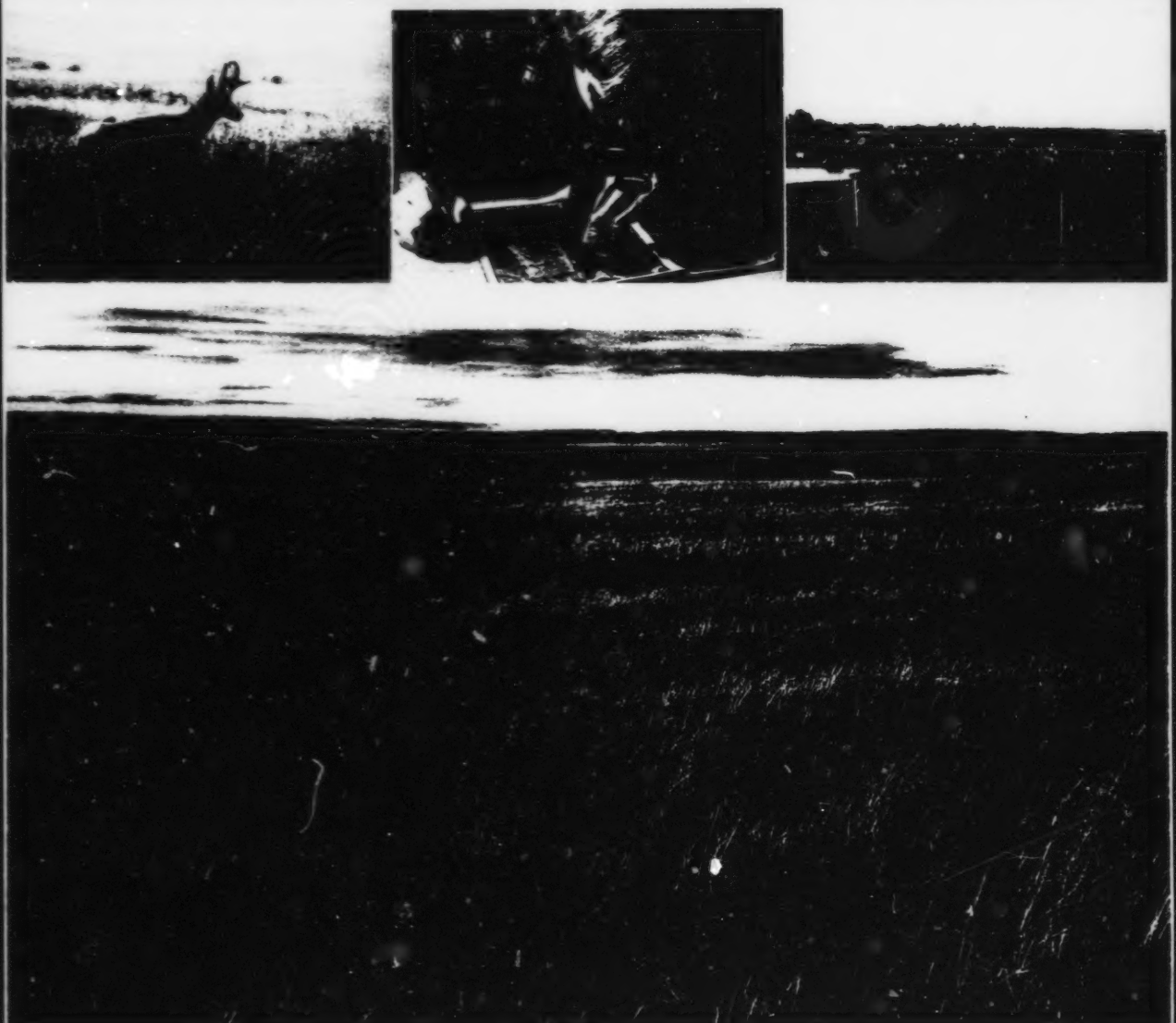
New Pasture and Grazing Technologies Project

A Practical Guide to Planning for Management and Improvement of Saskatchewan Rangeland

RANGE PLAN DEVELOPMENT



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A Practical Guide to Planning for Management and Improvement of Saskatchewan Rangeland

RANGE PLAN DEVELOPMENT

by

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March, 1990

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Lands

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Planning helps maximize the benefits from the range operation and maintains a healthy range, such as this fescue range.

INTRODUCTION

Rangeland may be defined as uncultivated land capable of providing grazing to wildlife and/or domestic animals. Pastureland, on the other hand is disturbed by periodic cultivation and receives agronomic inputs on a more or less regular basis.

Range management is the practice of manipulating the biological and physical components of the range for the purpose of obtaining maximum production of livestock products while maintaining the rangeland in a condition that assures this level of production is sustained. This can be achieved only through implementation of a properly prepared range plan. This booklet describes a planning procedure for rangelands that are used primarily for grazing by livestock and wildlife. If you are reading this guide for the first time, you should familiarize yourself with all sections of the publication prior to starting the planning process.

Why Planning?

As with any successful business, planning is an essential step towards **successful ranching**. A properly prepared and implemented range plan will help **maximize the benefits** from the range operation, and, at the same time, will help maintain the productive potential of the range.

Planning will ensure more **stable production** since it takes into consideration dry years and potential adverse conditions. In addition, planning will **reduce financial risk** (it is less costly to make mistakes on paper) and thus contributes to protecting your investment. Furthermore, planning will provide an overall analysis of your operation and provide a framework and direction for your ranch management.

Rangeland planning is particularly important in Saskatchewan for the following reasons:

1) Income comes mainly from a single product
2) Productivity of the land is low due to climatic or soil limitations
3) Year-to-year variations in forage production are substantial
4) Imbalance in the intraseasonal supply of forage is substantial
5) Proper planning is necessary to minimize the adverse effects of such factors.

Rangeland Inventory is the Foundation of a Range Plan. It Provides an assessment of the present and potential productivity of the range. Shown is a range technician determining forage yield.

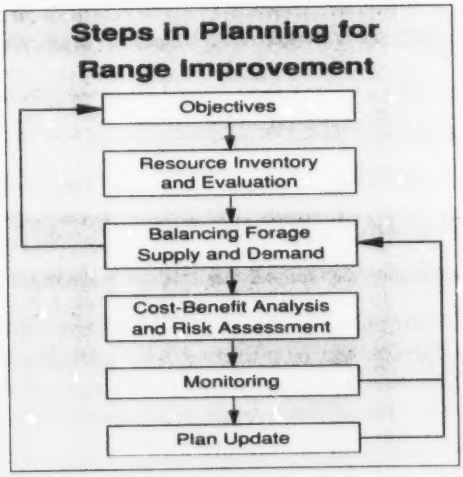


Fig. 1. *Framework for rangeland planning.*

A Framework for Planning

The framework for planning for range management is illustrated in Figure 1. Rangeland planning involves gathering information about the range as well as relevant external factors to achieve a specific range management goal(s). The processes of range resource inventory and evaluation can be considered as the **pillars of the range plan**. They form the basis for achieving the essential goal of balancing forage supply and demand. Before implementation of any plan, it must be economically feasible. Furthermore, plans have to be flexible to accommodate the changes in the internal environment as well as the changes in the external factors. Therefore, the planning process is an ongoing activity and does not end with the preparation of the first plan.

An overgrazed mixed prairie in the brown soil zone. The contribution of the valuable grass species to yield declined considerably.

STEPS IN PLANNING

The following are the steps involved in developing a range management and improvement plan:

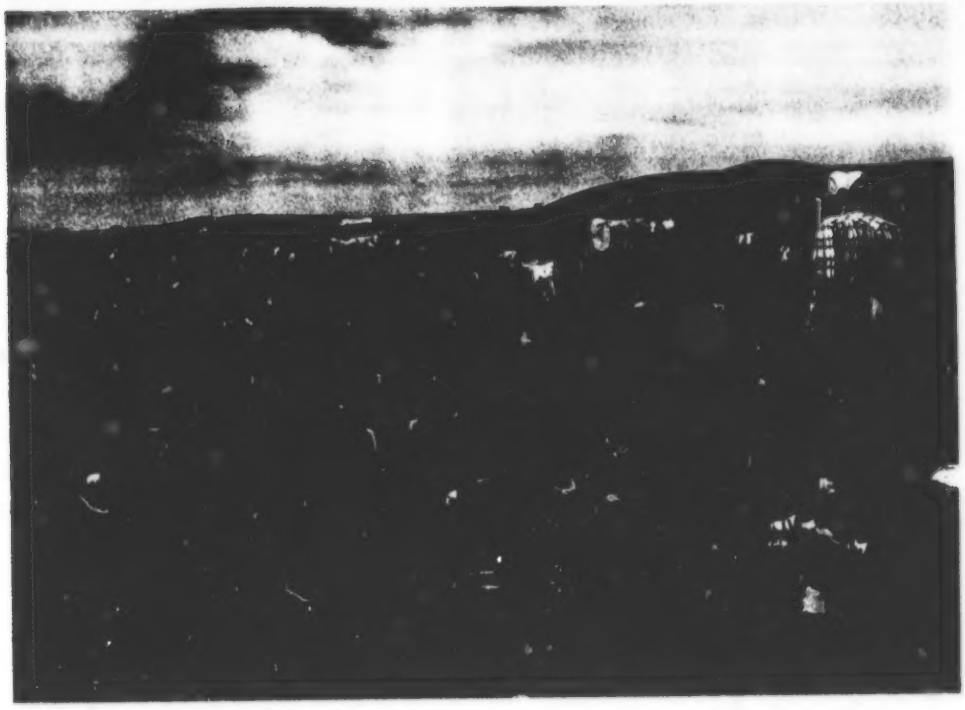
1) Define the goals and objectives of the operation
2) Gather the necessary information
3) Carry out a rangeland inventory and evaluation
4) Carry out the necessary range analysis
5) Assess the economics of the plan
6) Finalize the plan
7) Monitor the range and update the plan periodically

Although it is necessary to go through all the planning steps indicated above, it should be recognized that the process of range inventory and evaluation is the heart of the plan. When preparing a plan for the first time this process may require considerable amount of time and effort, depending on the size of operation. However, future updates will require much less time and effort. The above steps are described in the next sections. Because of the importance of the range inventory and evaluation step, it is treated in this publication in greater detail than any other aspect of the planning process.

STEP 1: SETTING OBJECTIVES

Setting goals provides a definite direction and focus for your operation. The first step is to define the strategic or long-term goal(s) (5-10 years) of the operation. Here, one answers questions concerning the type of operation desired. This involves considering and weighing the relative merits of the various types of enterprises such as a cow-calf operation, a yearling operation, a sheep ranching enterprise, or a game ranching project. While this publication focuses on the use of rangeland for grazing, the range analysis procedure described here is applicable to most other uses. This is because it provides a comprehensive evaluation of the present and potential range resources. The requirements of the other uses can then be integrated into the plan according to established priorities.

Once the strategic goal has been determined, short-term (1-4 years) or operational goals are then defined.



Knowledge of the pattern of the livestock use and movement is essential for planning of proper grazing distribution.

Operational goals may be viewed as intermediate goals leading to the achievement of the ultimate or strategic goal. The goals should be as specific as possible and should be priorized according to their importance to the operation. Operational goals may be grouped into two categories: (a) primary goals and (b) secondary goals. Work towards the secondary goals only after you have achieved your primary goals. Develop a schedule for attaining the specific goals selected. This could be done initially for each year and then detailed to at least a monthly basis.

Short-term goals may be expressed in financial terms such as achieving a certain level of income. The size of herd or operation that can generate this income is then determined on the basis of local experience and available statistics. Although objectives may vary widely depending on local conditions, the following are some common examples of goals:

1) Maintain existing productive capacity of the ranch
2) Maximize profit from existing operation
3) Minimize costs of the existing operation
4) Minimize loss during drought years
5) Increase the size of existing operation by 15% by a certain date.

Defining the goals of the operation should reflect previous work experience, family circumstances, personal aspirations as well as market realities and market prospects for the product being contemplated. However, at this stage, the manager should not address the question of how the goals are achieved. This is addressed after gaining the necessary knowledge about the present state of the range as well as its potential capability.

STEP 2: INFORMATION GATHERING

For proper rangeland planning you need three types of information:

1) Information pertaining to your operation, for example, history of land use, records of actual stocking rates, and results of previous range improvement operations. Your personal knowledge of such aspects as grazing patterns will help a great deal in the planning process.

Use of air photos facilitates the planning process greatly.

2) Information pertaining to the external environment such as present livestock market, future livestock market trends, availability and price levels of supplemental feed supplies, interest rates, availability and wages of hired help, fencing costs, grazing fees, precipitation and other climatic parameters.

3) Technical information on various aspects of rangeland management, range improvement, and soils that is available from various sources (see list of recommended further reading in the last section of this publication).

The information obtained will aid in the range analysis and economic assessment phases of planning.

STEP 3: RANGELAND RESOURCE INVENTORY

Proper range management planning requires a thorough knowledge of the range resources and their capabilities. This knowledge is obtained through rangeland inventory and evaluation. Range inventory and evaluation information strongly influences virtually all phases of the ranch operation. It provides the basis for decisions regarding such important factors as stocking rates, type of grazing management, and the type of improvement practices possible. These factors are the determinant of the profitability and sustainability of the operation.

Rangeland inventory and evaluation will further:

1) help in identifying rangeland management problems such as poor range condition, underutilized areas, and presence of poisonous plants;

2) help in determining possible causes of the problems identified such as grazing distribution, inappropriate stocking rate; and

3) find possible solutions to the management problem such as correcting distribution problem and adjusting stocking rates.

Proper rangeland inventory requires familiarity with soil classification, range plants, air photo interpretation and range ecology. This section describes a simplified procedure for inventory and evaluation that can be implemented with minimal background. However, it may be desirable to seek the help of the rangeland specialist in your area at least in the initial stages of the process.

Air photo maps can be used as a base for your range map.

A biophysical inventory is a survey of the physical and biological components or resources of the range. In addition to surveying the kind, class and number of animals in the present operation, it is necessary to identify or determine and map the following rangeland features:

1) cultural features
2) range sites (kinds of rangeland)
3) vegetation types
4) range condition (health of the range)
5) use pattern

Use air photos or photo maps to identify and map the cultural features such as watering points, fences, trails, salting locations, corrals, and sheds. Air photos and photo mosaics of various scales are available from Central Survey and Mapping Agency in Regina. The use of a pocket stereoscope will aid greatly in interpreting both natural and cultural features.

Air photos are also helpful in identifying and mapping range vegetation types. Include the main vegetation types such as: native grassland, wetland, aspen woodland, cultivated pastures and hay fields. Seeded pastures and hay fields have smoother and more uniform texture and lighter tone on air photos than native grassland and shrub or tree-dominated areas. Native grasslands has a smoother texture and lighter tone than shrub-dominated and wooded areas.

Range sites can be determined using air photos and/or soil maps. Detailed information on Saskatchewan range sites and how to identify them is given in a later section.

Determination of range condition and range use pattern relies primarily on field surveys. This is discussed in a later section.

A range map is the central piece of the plan. A sample of the basic range map is given in Figure 2. Air photo mosaics or topographic maps can be used as a base. The various features and components of the range inventory can then be mapped on overlays (Figure 2). These will be needed for the plan preparation phase.

The range map should be accompanied by the detailed written account of field inventory data. The range site, vegetation, condition and use information should be indicated for each field. The areal extent of each range site in each field should be determined. Suggested inventory sheets are given in a later section.

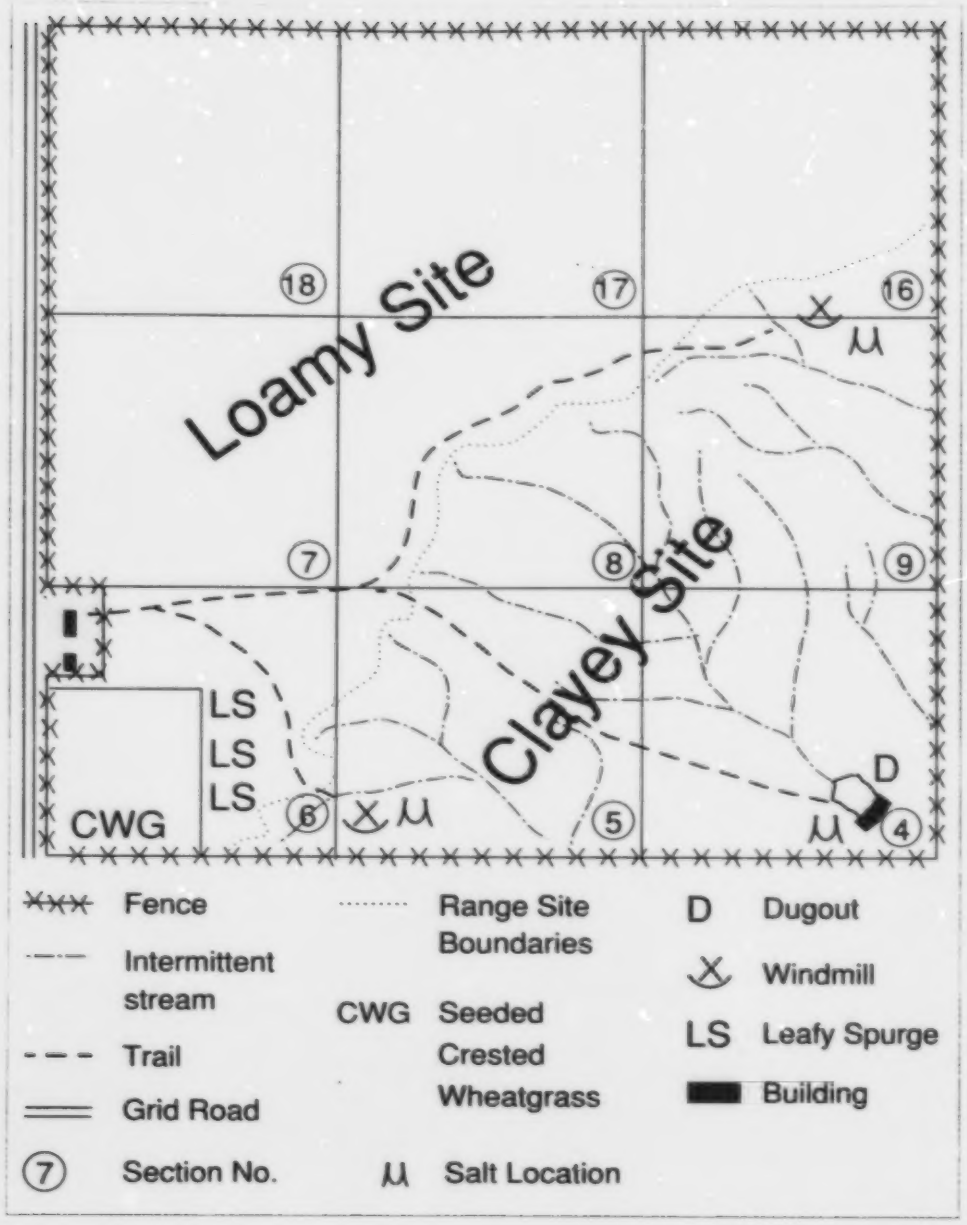


***Fig. 2.** A basic range map showing some natural and cultural features.*

STEP 4: RANGE ANALYSIS

The purpose of this stage is to prepare an initial operational plan upon examination and analysis of the collected information and data. This analysis should be carried out only after a clear understanding of the established principles of grazing management. These principles reflect the complex interrelationships among the various components of the range ecological system. A brief consideration of grazing management is given below.

Grazing Management Considerations

Grazing management is the most important tool available for maintaining and improving rangeland. Rangeland differs from artificial or arable grasslands in that it supports complex plant communities in comparison to the monoculture often encountered in cultivated pastures. Different plants respond to

Moderately used mixed prairie.

management and improvement practices differently, making management of rangeland more difficult. Furthermore, intensive renovation of degraded forage stands is often possible in arable grasslands, but usually not in rangeland. Therefore, management of arable grasslands is intensive in nature and is agronomically based while that of rangeland is extensive and is ecologically based. It should be emphasized, however, that even in arable grassland, the application of ecological principles has an important role.

In this section, the principles of rangeland grazing management are outlined. Specialized grazing systems are discussed in other publications (see list of suggested further readings at the end of this publication).

The four basic principles of grazing management are:

1) proper grazing use of the available forage
2) proper time and season of use
3) proper distribution of grazing pressures
4) proper kind of livestock

Proper Use

Correct use (also called proper use or full use, see Table 1) is the most important principle of grazing management. It is essential for maintaining or restoring range productivity so that a high level of animal production can be maintained. It is generally agreed that for native rangeland, proper use is achieved when an average carryover of approximately 45% is maintained. Carryover is the amount of forage remaining on a range at the end of the grazing season. The above level of carryover assumes continuous grazing

Use rate	Percent Utilization	Description[u]
Unused	None	No livestock use. Fire hazard is high if continued for several years.
Slight	<20	Largely undisturbed range. Only favored areas (near water, trails and shade) and choice plants are grazed. Not economical, unless used for range improvement purposes.
Moderate	20-40	Grazing in nearly all areas of pasture. Little use is made of poor forage. Limited livestock trails.
Full or Proper	40-60	Grazing in nearly all areas of pasture. Most areas show proper use of key forage plants. Overuse on less than 10% of area.
Heavy	>60	Key species are heavily utilized. Substantial use of the less desirable plants and poor quality dry and stemmy forage is being made. Livestock trailing to forage may be evident.

Table 1.
Range use categories (utilization is expressed as percentage of current year's growth of key species).

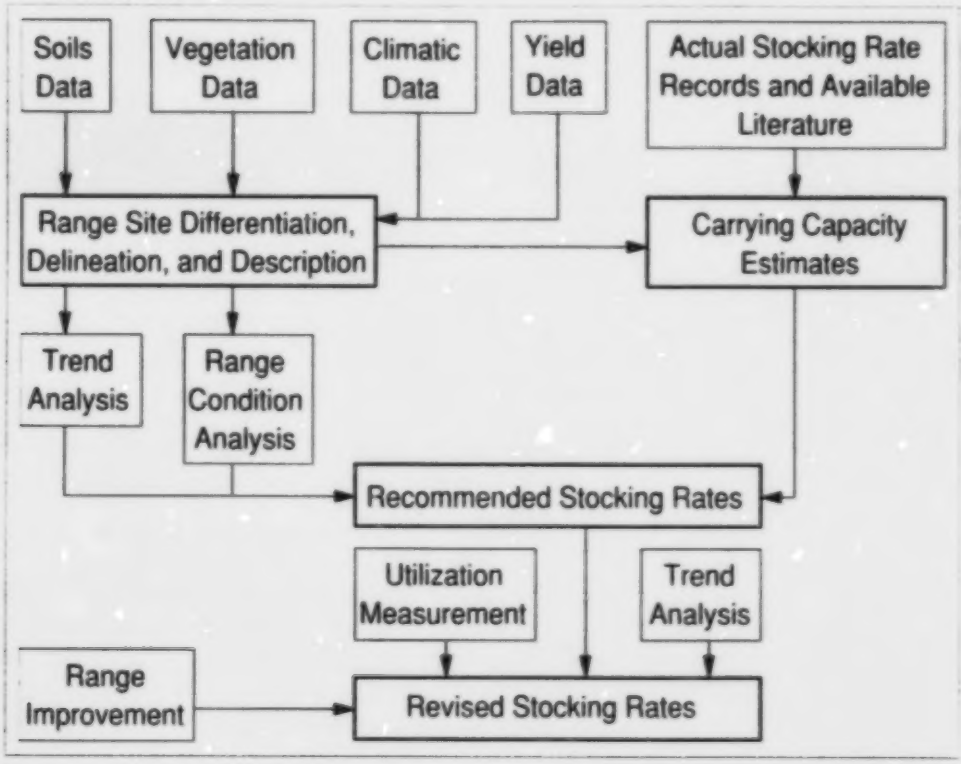


Fig. 3. *Summary of the procedure used to determine stocking rates. (Adapted from Abouguendia et al. 1982)*

during the summer. Less carryover is required when adopting certain grazing systems or when grazing takes place during the dormant season.

Proper stocking rate that would result in correct use depends on such factors as (Figure 3):

1) Characteristics of the climate, particularly precipitation
2) Quality of the range site (for example, soil characteristics, topography)
3) Type of vegetation (for example, grassland and aspen)
4) Range condition or 'health' (or how close the present production is to the potential productivity of the site) and trend in range condition
5) Grazing management factors (for example, availability of stock watering facilities, accessibility, season of grazing and grazing system used)
6) Current growing season conditions, particularly the amount and distribution of precipitation.

Usually, an initial stocking rate is determined on the basis of the first four factors listed above. This rate is then

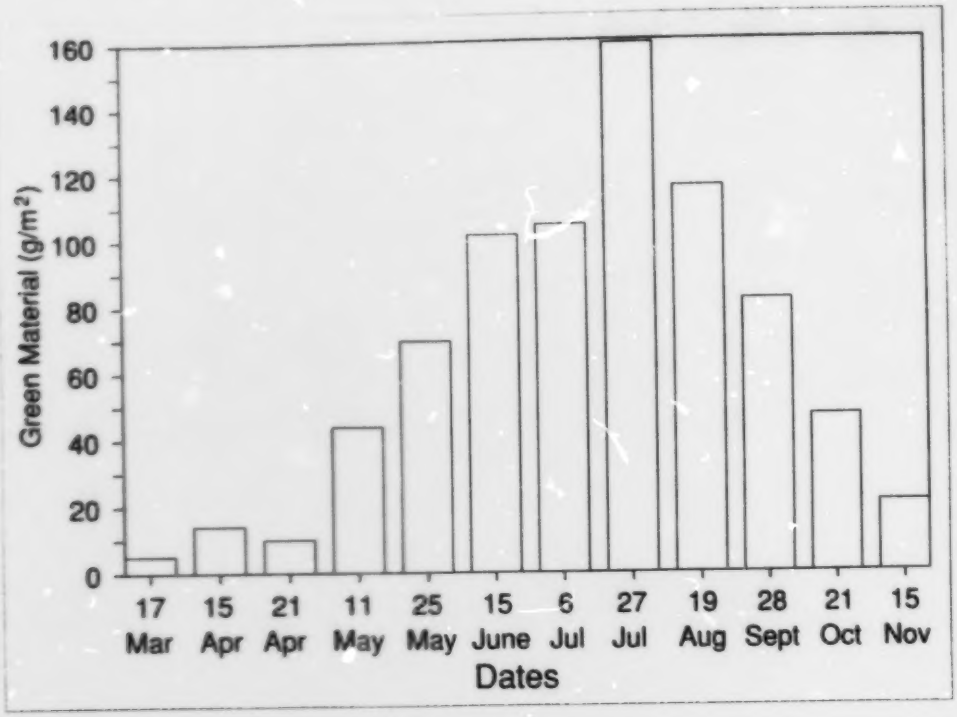


Fig. 4. Seasonal pattern of current year's green plant material for a mixed prairie grasslands (Based on 3-year data from the Matador area).

adjusted in light of the specific conditions pertaining to the remaining factors. This procedure is described in detail in a later section.

Proper Time and Season of Use

The time at which grazing starts in the spring depends on the stage of plant development and soil conditions. The growth of native rangeland plants is slow during early spring and reaches maximum level some time during the last week of July (Figure 4). In the early spring, plants start regrowth using food reserves stored in their underground parts and in their crowns. Further growth is necessary to produce sufficient leaf area for adequate photosynthesis and subsequent food elaboration processes. Too early grazing would reduce the leaf area and will reduce the opportunity for replenishing food reserves and reduce root biomass. This will result in a weakened plant and even death, particularly if this is repeated over several consecutive years without appropriate rest. Too early grazing is also more damaging in years when the conditions following defoliation are not favourable for growth, e.g., drought.

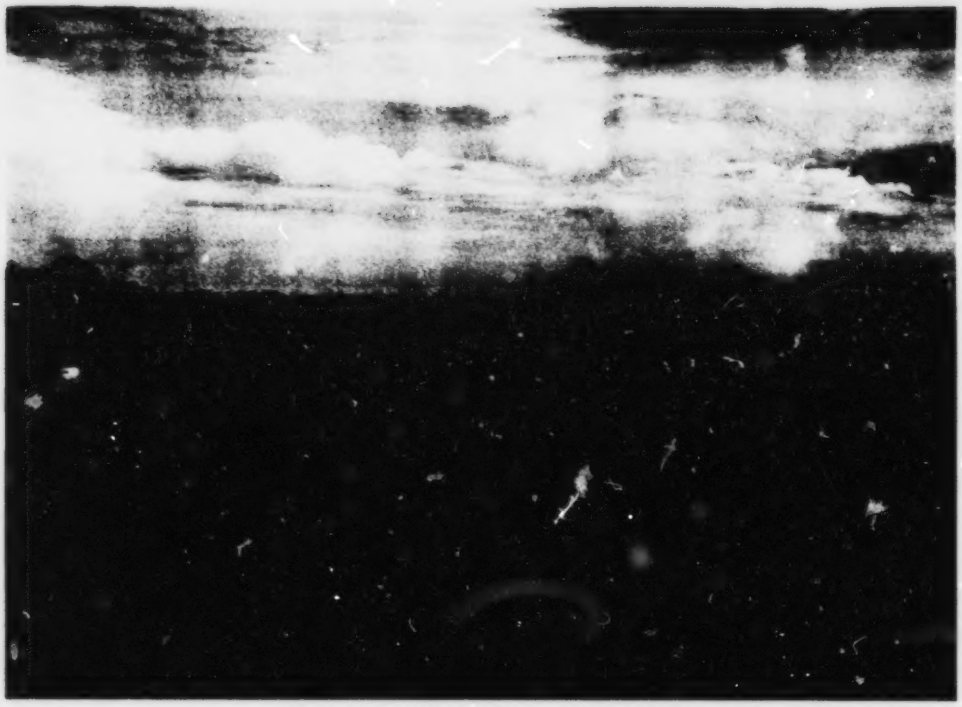
The term range readiness defines that point in the plant growth cycle at which grazing may begin with minimal damage to vegetation and soil. Range readiness varies from one place to another depending on (Figure 4.)climatic conditions, range condition, vegetation type and soil fertility. It also varies from year to year depending on current weather conditions. Several indicators have been suggested for determining the date of range readiness:

1) when the principal grasses attain certain height; for example, 3-4 inches of leaf growth is suggested for mixed prairie and 8 inches for rough fescue.

2) when certain plants flower; for example, in the mixed prairies, grazing should not start until the golden bean is in full flower: for the fescue prairie when the shooting star is flowering; and for the parkland when native roses begin to bloom.

In some years, range soils may be so wet in the spring that grazing animals could damage soil structure and lower plant productivity. This is particularly critical in lowland with fine-textured soils.

Certain types of cultivated pastures, crested wheatgrass for example, produce



Proper spacing of water points is an important tool in improving grazing distribution.

earlier growth than native rangeland and when available should be used to delay grazing of native rangeland in the spring. Deferred rotation grazing and fertilization are other useful techniques for minimizing the adverse effects of early grazing. Greater production could be obtained from your native rangeland as a result of delaying grazing even further than is suggested by range readiness.

Selection of the season of grazing should take into consideration the nutritional requirements of livestock in addition to vegetation growth requirements. For example, native range forage is low in protein and phosphorus and high in carbohydrates during the fall. This nutritional imbalance may be overcome by using a Russian wildrye-alfalfa mixture.

Proper Distribution of Grazing Pressures

Proper distribution of grazing is another important basic range management principle. A range may be stocked properly during the proper season and still suffer from overgrazing in certain locations. Usually small areas (5-10%) around watering points and near gates are sacrificed. But extensive areas of overgrazed rangeland are unacceptable.

Improper grazing distribution is a common problem in Saskatchewan rangeland, particularly in ranges with diverse topography and vegetation. Grazing distribution problems may be caused by such factors as:

1) type of vegetation (for example, bush vs grassy opening, wetland vs upland vegetation, differences in palatability)
2) topography (e.g., bottomland vs slopes and upland)
3) animal factors (kind and habits of livestock, selectivity)
4) size and shape of pasture
5) relative location of range facilities such as water and salt, trails, gates.

The methods used to correct grazing distribution problems vary depending on the underlying causes of the problem. Some of these methods are discussed in a later section.

Proper Kind of Livestock

Using the kind of livestock that is most compatible with the available range is not always possible. The kind of animals can influence range management requirements due to such factors as for-

Type of Forage or Feed	Field Number	Acres	AUM/acre	Total AUM's
Grand Total AUM's				

Table 2.
Summary of forage and feed inventory.

age preference and the manner in which they graze and react to site characteristics, such as topography.

It should be recognized that there are differences in the choice of plants taken by different kinds of animals. Cattle and horses prefer grass to a greater degree than do sheep and goats. Goats and sheep consume more forbs and browse than cattle and horses. The use of the right kind or mix of animals may contribute towards range improvement.

In some cases, the selection of the proper kind of animals may solve a specific range problem. For example, ranges infested with leafy spurge could be grazed by sheep. Leafy spurge, a common weed in the southeastern part of the province, is rarely used by cattle. Heavy grazing by sheep may even contribute towards its control.

Forage Supply and Demand

Forage audit, the equivalent of a financial audit in accounting, is a basic range analysis step. It is a process of examining the forage supply and demand status of the operation. It involves consideration, if necessary, of ways to increase forage supply to achieve the manager's goals. In this audit, all available forage sources from the present operation should be included. Such sources would include native rangeland, cultivated pastures, hay* fields, field crop stubble, annual forage crops, and supplemental feed. The range forage inventory and evaluation data (previous section) may be summarized in a table form (Table 2).

Distribute available forage (total AUM's) over the year according to the appropriate season of availability and use (Table 3). For example, crested wheatgrass and Russian wildrye should be considered for spring and fall grazing, while native range is grazed in the summer.

Once the available forage supply has been determined, the animal forage requirements are then calculated on a monthly or seasonal basis (Table 4). These requirements should be calculated on the basis of the herd size needed to satisfy the manager's goals. Note that forage demand changes during the year due to such factors as calving, selling or buying of animals. Note also that both

* to convert tons of hay to AUM's multiply by a factor of 2.8.

Months (or seasons)	Native	Seeded Pasture	Hay	Stubble	Others	Total Available AUM's
May						
June						
July						
August						
September						
October						
Nov.-April						

Table 3.
Available forage from various sources by month or season.

	May	June	July	August	Sept.	Oct.	Nov.-April
Bulls							
Cows							
Replacements							
Yearling Steers							
Calves							
Purchased Steers							
Total AUM's Required							

Table 4.
Livestock inventory sheet (AUM's)

forage supply and forage demand are expressed in a standardized unit called "Animal Unit" or AU. An animal unit is a 1000 lb mature cow. An Animal Unit Month (AUM) is the amount of forage required by an animal unit for one month. Conversion from the various kinds and classes of animals to animal units can be done using the Animal Unit Equivalent Table (Table 5). To adjust for cow size add 0.1 AU for every 100 lb above the standard weight of 1000 lb, or simply use Figure 5 for that purpose.

Now compare forage supply and demand using the summary table (Table 6) for each year in the plan. Identify any variances between the monthly forage supply and demand. If the present supply satisfies forage requirements, then no changes in management are necessary and the plan may be finalized. More often, however, forage demands exceed the available supply. In such cases, certain management and/or improvement measures should be considered.

KIND/CLASS OF ANIMALS	ANIMAL UNIT EQUIVALENT
Cattle, mature cow *	1.00
Cattle, mature cow, with a calf *	1.00
Cattle, weaned calves	0.50
Cattle, yearlings	0.70
Cattle, bull	1.50
Horse, at least 3 years old	1.50
Horse, 2-year olds	1.00
Horse, Yearlings	0.75
Sheep, ewes	0.20
Sheep, rams	0.26
Sheep, one year or younger	0.15
Deer	0.20
Antelope	0.10
Bison	1.25
Elk	0.85

* This is based on a 1000 lb animal. Adjustment must be made for heavier animals. Use Figure 5 for this purpose.

Table 5.
Animal Equivalent Guide.

First consider low-input grazing management practices, such as improving grazing distribution, as means for increasing forage supply. If the expected increase in forage from such measures does not provide the additional forage needed,

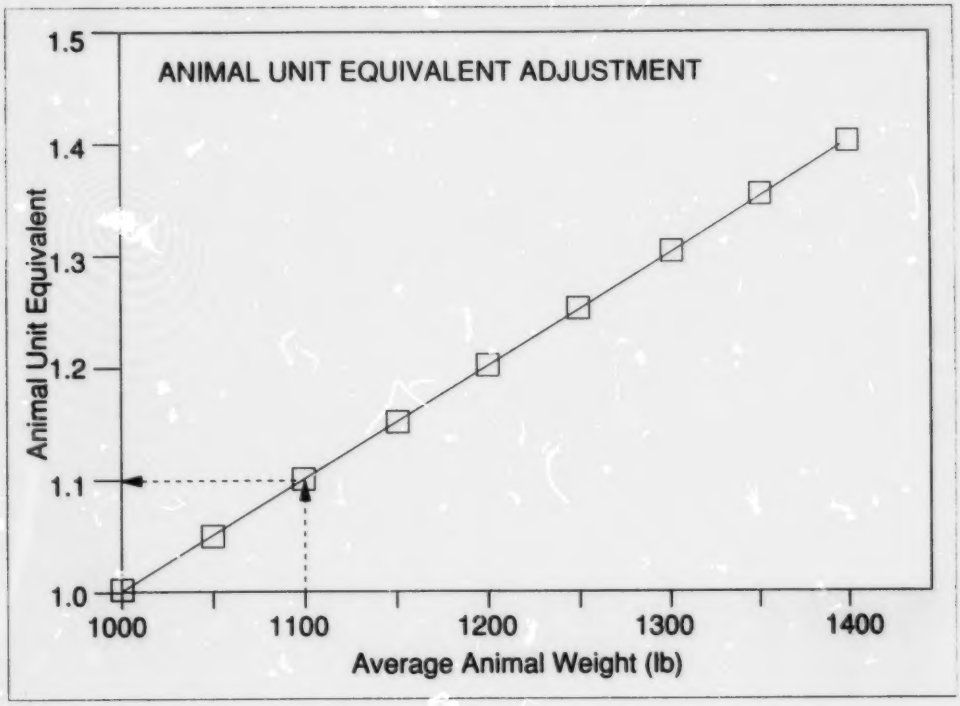


Fig. 5. *A graph to be used in adjusting for cattle size in calculating stocking rates (start with the average weight and then follow the example shown with a dotted line*

Months (or seasons)	Total AUM's Available	Total AUM's Required	Variance
May			
June			
July			
August			
September			
October			
Nov.-April			

Table 6.
Forage balance sheet

then consider adopting a specialized grazing system. If additional forage is still needed, other range improvement practices may be considered. These include: fertilization, brush control, and or seeding (see list of suggested further readings). Further forage may be secured through seeding of marginal cropland to perennial or annual forage crops; rental of native rangeland, cultivated pastures, or hay fields; or purchase of hay or supplemental feed. It is desirable to consider more than one of the above alternatives. This will allow you to compare and select the most cost-effective option based on the economic analysis.

Once the forage balance has been attained, work out the details of the planned changes, such as the length and type of new fences required, areas to be seeded, kinds of plants and varieties to be seeded, kind of equipment needed and the amount of seed and fertilizers needed. Such details, together with the information collected during the second step, would be needed for the next stage dealing with the economic assessment. Be sure to indicate any planned changes in management (for example new cross fences, new watering points) and any planned improvements on a range map overlay (Figure 6).

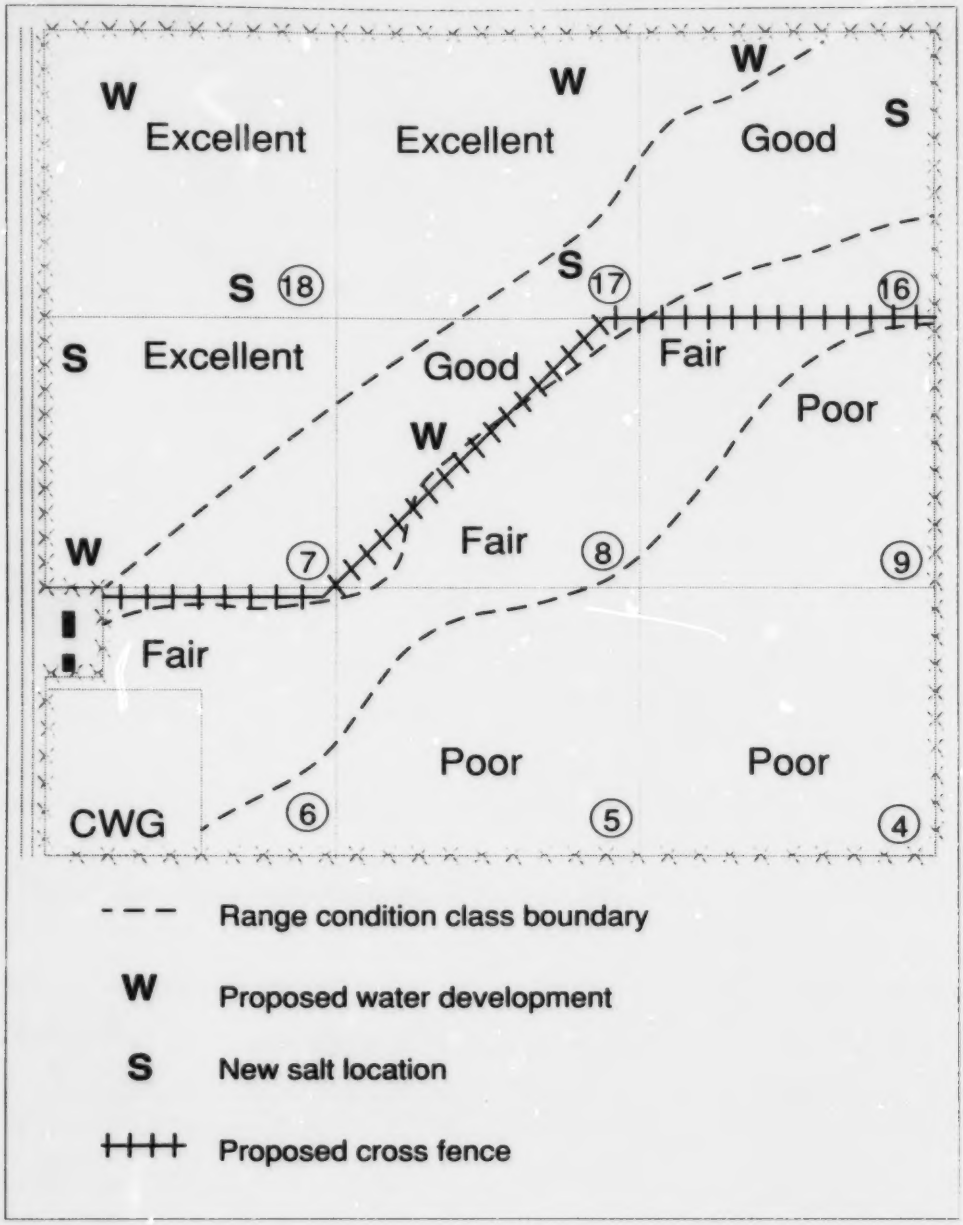


Fig. 6. *A map showing some simple grazing management measures designed to improve range condition and grazing distribution.*

STEP 5: ECONOMIC ANALYSIS

In the previous step, you selected range management and improvement measures that are technically feasible and that are within the capability of the range. This step helps you decide whether the management and improvement practices you are considering make sense from an economic point of view. Economic analysis can also assist in determining the optimum level of investment, and in examining and comparing the various improvement and management options and cash-flow alternatives. Economic analysis is not treated in any detail in this publication. Therefore, it would be desirable to consult with the nearest farm management specialist for more information on economic analysis.

For this phase, you will need the relevant internal and external information (Step 2) to be able to carry out this assessment. Of particular importance is the information related to interest rates, livestock market, price and availability of

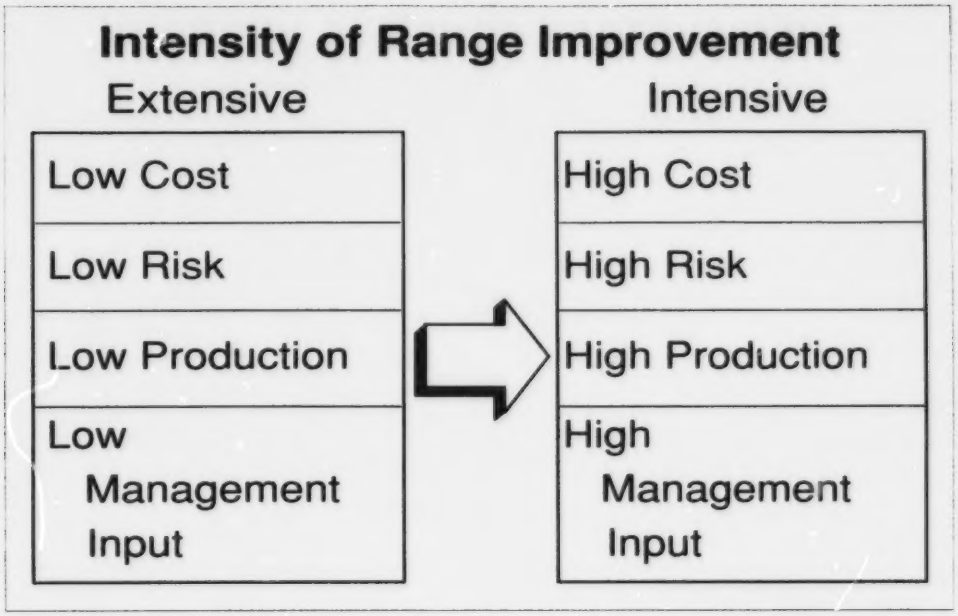


Fig. 7. *Relationship between range improvement intensity and investment requirements, production, and risk. (Adapted from Herbel, 1983)*

materials and supplies, and expected increase in forage quantity and quality from the various range management and improvement practices.

Here, you will need to make decisions regarding the level of investment you are willing to use and the level of risk you are prepared to take. Risk increases proportionally to management intensity (Figure 7). For high risk practices, you may want to try it first on a small scale to reduce the risk. Furthermore, alternative uses of the money should not be overlooked in the analysis.

When considering the various options or alternatives, always make your comparisons with a "no-change option", which is merely a continuation of the present operation. All costs and returns from each option must be included in the analysis.

In the economic analysis, you should amortize the investment over the life of the improvement practice being considered. Amortization simply means dividing the total cost of a capital improvement into annual installments over the life of the improvement. If the funds needed are to be borrowed, the length of the loan period determines the amortization period. The amortization factors given in Table 6 are given for selected interest rates for a certain period of time to repay a debt of $1.00. As an example consider a rancher borrowing $2000 for a range fertilization program. Assume an interest rate of 12% and that most of the benefits from fertilization will be realized during the first three years. The amortization factor will then be 0.41635 (Table 7). The required annual payment would be 2000 x 0.41635 or $832.7. The expected benefits from fertilization must exceed that amount if the rancher is to make any profit from it.

For some improvements, you should add the annual maintenance cost. An example of this type of improvement is fencing and brush control. In other cases, grazing may be lost for a certain period of time. In such cases, you should include the cost for hay, supplemental feeding, or rental fees into your analysis. Also, you should account for all the benefits expected from any of the management or improvement practices being considered. When considering fertilization, often only increase in forage yield is taken into account. However, other benefits from fertilization (improved forage quality, improved grazing distribution, earlier forage production, improved plant water use efficiency) can be substantial.

STEP 6: FINALIZATION OF THE PLAN

Upon completion of the economic analysis you can start finalizing your

Number of Years	9%	10%	11%	12%	13%	14%
1	1.09000	1.10000	1.11000	1.12000	1.13000	1.14000
2	0.56847	0.57619	0.58393	0.59170	0.59948	0.60729
3	0.39505	0.40211	0.40921	0.41635	0.42352	0.43073
4	0.30867	0.31547	0.32233	0.32923	0.33619	0.34320
5	0.25709	0.26380	0.27057	0.27741	0.28431	0.29128
6	0.22292	0.22961	0.23638	0.24323	0.25015	0.25716
7	0.19869	0.20541	0.21222	0.21912	0.22611	0.23319
8	0.18067	0.18744	0.19432	0.20130	0.20839	0.21557
9	0.16680	0.17364	0.18060	0.18768	0.19487	0.20217
10	0.15582	0.16275	0.16980	0.17698	0.18429	0.19171
11	0.14695	0.15396	0.16112	0.16842	0.17584	0.18339
12	0.13965	0.14676	0.15403	0.16144	0.16899	0.17667
13	0.13357	0.14078	0.14815	0.15568	0.16335	0.17116
14	0.12843	0.13575	0.14323	0.15087	0.15867	0.16661
15	0.12406	0.13147	0.13907	0.14682	0.15474	0.16281
16	0.12030	0.12782	0.13552	0.14339	0.15143	0.15962
17	0.11705	0.12466	0.13247	0.14046	0.14861	0.15692
18	0.11421	0.12193	0.12984	0.13794	0.14620	0.15462
19	0.11173	0.11955	0.12756	0.13576	0.14413	0.15266
20	0.10955	0.11746	0.12558	0.13388	0.14235	0.15099

Table 7.
Amortization factors for selected interest rates.

plan. The plan should be simple but specific. Modify your map overlays, and write-up to reflect the decisions made during the preceding step. Do your planning for each field and even for each range site within each field. For each range site and/or field, specify the planned actions and their requirements (labour, materials, etc.). Some of the common range management actions (see list of suggested further readings) are listed below:

1) Stocking rates: increase, reduce, or maintain same rates.

2) Modify grazing period or season.

3) Livestock: change or add new kinds or classes of animals, acquire more animals, or cull animals.

4) Livestock water facilities :develop new ones, close some or improve some.

5) Fencing: build new fence or cross fence, remove cross fence, add or change location of gates.

6) Salt and mineral supplement: add new salt trough or blocks, relocate salt, or rotate salt location.

7) Fertilization: fertilize a lightly used area to improve distribution, or fertilize an area to obtain earlier grazing.

8) Adopt a specialized grazing system.

9) Seed marginal farmland.

10) Seed depleted range area.

11) Apply mechanical treatment.

12) Control undesirable plants.

13) Rent additional rangeland or cultivated pasture.

14) Make arrangement for hay and supplemental feed supplies.

Once the details of the various actions have been determined, develop a financial plan and a timetable for plan implementation. The schedule should reflect your priorities and needs and the availability of financial resources.

A contingency plan must be developed to minimize the adverse effects of drought and other adverse conditions. The implications of the fluctuations in forage production are discussed in a later section.

STEP 7: MONITORING AND UPDATING OF THE PLAN

The successful attainment of the manager's goal depends not only on the development of the appropriate plan but also upon the care with which the plan is implemented. To facilitate the implementation of any changes or adjustments required, prioritization and scheduling are an essential part of the plan. Adjustments may be classified into:

1) Immediate adjustments where immediate actions or measures are needed.

Degree of slope affects grazing potential of the range. Utilization cuts must be made for steep slopes such as shown here.

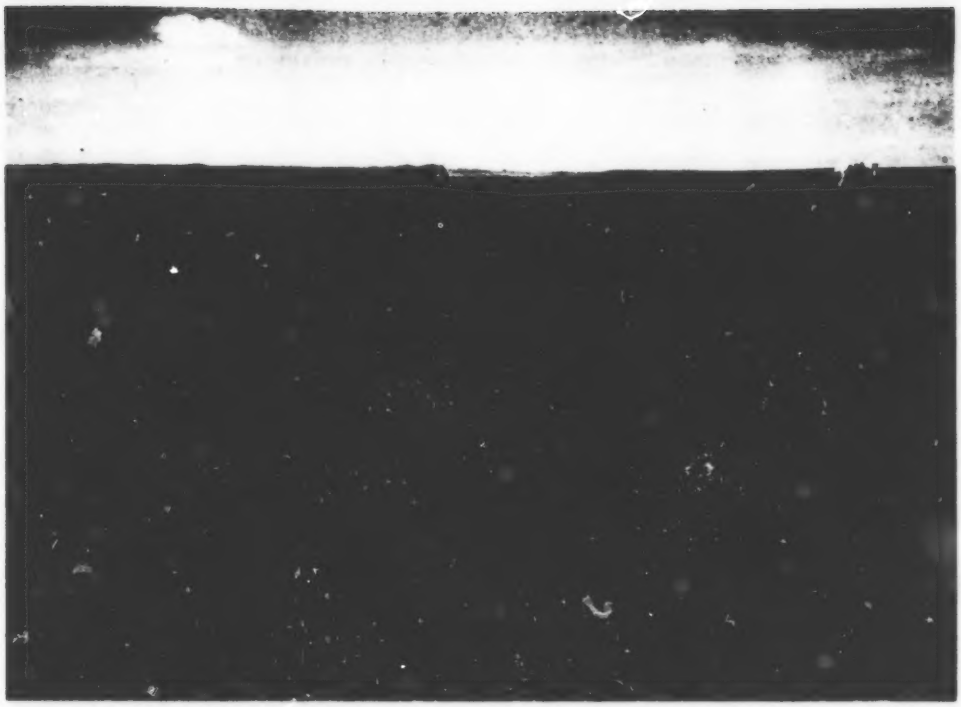
2) Gradual or delayed adjustments with intermediate priority actions or measures.

3) Lower priority adjustments which aim at achieving a secondary operational goal.

Flexibility in the implementation phase is essential. Changes in the external environment do occur and should be taken into account during this phase and the plan should be updated if necessary.

Any range plan should have a provision for monitoring. Monitoring is an important tool that will help you determine the need for modifications of the plan in order to make optimum use of the range resources. You need to monitor range condition and trend to assess the response of the range to the new management and improvement actions. More information on monitoring is given in a later section.

In addition to the usual bookkeeping practices, keeping records of range management information should be an essential part of the operation. Management information should cover such aspects as: rangeland inventory, evaluation, monitoring, stocking rates, improvement practices, grazing management and animal performance.



An upland range site on alluvial deposits in the brown soil zone. Range is classified as good.

RANGE SITES

Range Site Determination

Different kinds of rangeland are called range sites. These are ecological subdivisions into which rangeland is divided for the purpose of study, evaluation, and management. Identification of range sites is an essential prerequisite for range evaluation and analysis. Major range site factors which influence forage production and range management are:

1) Soil moisture: Available soil moisture depends on such factors as soil depth, texture, organic matter, topography and the amount of precipitation and evaporation characteristic of the region.
2) Soil nutrients: Available soil nutrients depends largely on organic matter content, soil texture and the type of parent material.
3) Salinity: Soil salinity is influenced by the type of parent material, internal drainage and soil texture.

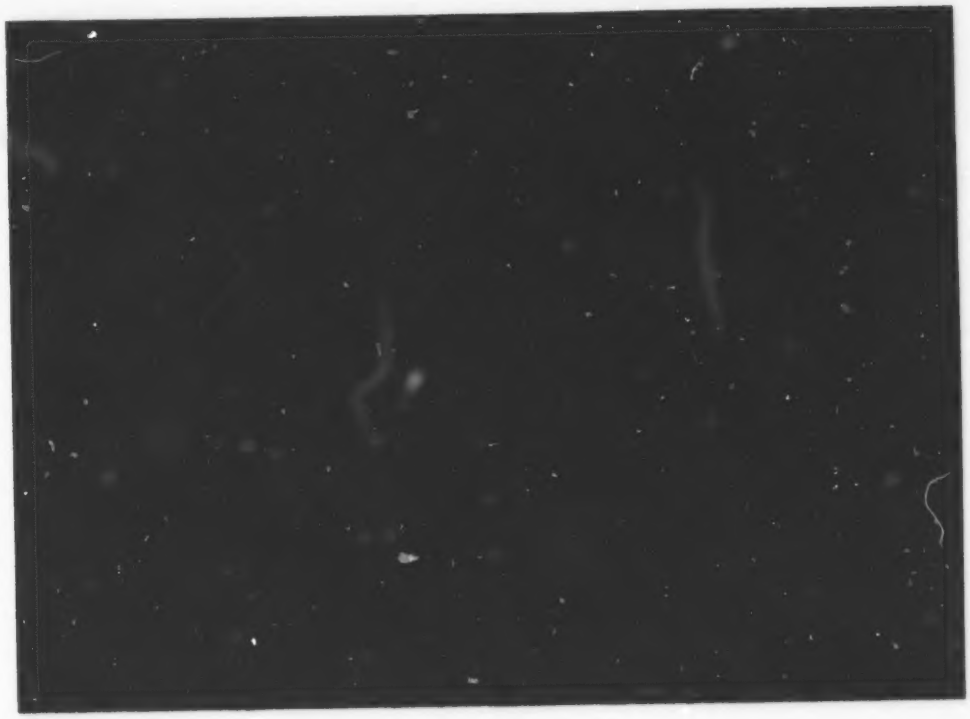
Each range site has its own characteristics which result in a specific plant community or a level of productivity that make it different from other range sites. In practice, range sites for a particular region are commonly **determined** on the basis of the following criteria:

1) differences in the dominant plant species in the "climax" or original plant community;
2) differences in the proportion of the most important species in the "climax" plant community.
3) differences in the total annual yield of the "climax" plant community.

Range Site Description

Within a climatic zone or region, range sites may be grouped into the following categories mainly on the basis of the soil moisture regime:

1) Normal upland sites: Normal uplands reflect the normal response to the climate of the region. The soil moisture regime here is considered average for that climate. The Saskatchewan upland sites are: sands, sandy, loamy and clayey.
2) Other range sites: Due to significant variations in topography, drainage or type of parent material, certain range sites are characterized by drier or wetter moisture regimes than the



Dune sand range site is susceptible to erosion and overgrazing could convert it into a nonproductive area.

normal uplands. Examples of areas receiving greater than average moisture are wetlands and saline lowlands. Sites that exhibit greater than average moisture limitations include gravel, saline upland and steep slopes.

The following is a brief description of some of the range sites found in Saskatchewan:

Normal Upland Sites

1) Sands: These are nearly level to rolling land with deep, loose, coarse-textured soils (coarse to very fine sands). This site is characterized by very weak soil development and high wind erosion hazard. Permeability is rapid and water holding capacity is low. Common soils classified as sands range site include undifferentiated sand, regosolic sands and loamy sands.

2) Sandy: These are nearly level to rolling land with somewhat finer soil texture than in the previous site (fine sandy loam, loamy fine sands, loamy very fine sands). The soil is darker than in the preceding site reflecting greater soil development. Permeability is moderate to rapid and available water capacity is moderate. The potential for soil erosion by wind is relatively high. Examples of this include Chaplin sandy loam, Biggar sandy loam and other light loam soils.

3) Loamy: Loamy sites include gently undulating to rolling uplands with medium to moderately fine-textured soils (loam, clay loam). The soils are deep with well to moderately well drainage. Examples of soils included in this site are Haverhill loam, Weyburn loam and Oxbow loam.

4) Clayey: These are nearly level to rolling uplands with moderately deep, well-drained, fine textured soils (e.g., clay, heavy clay). This site is mostly associated with glacial lake plains (lacustrine plains). Clayey sites include Sceptre heavy clay and Elstow clay soils and other fine-textured soils.

Range Sites With Drier Moisture Regime

1) Dune Sands: The dune sand site is characterized by very rough topography with deep, coarse-textured soils (loose sands). Little or no soil development is noted in this site. Soils grouped under this site include Dune Sands, Antelope Regosol, and Vera regosol. Sand

A burnout range site in brown soil zone.

dunes with only sparse vegetation cover are considered unsuitable for grazing.

2) Burnouts: These are nearly level lands with moderately fine to moderately coarse-textured soils underlain by dense, slowly permeable subsoil that is high in sodium. This site occurs mainly in the southwestern corner of the province (solonetzic soils such as the Echo Association).

3) Thin Upland or Shallow: These include shallow soils with various textures occurring on steep slopes. The weakly developed soils characteristics of this site restrict plant rooting. Soil water holding capacity is low. Examples of this include soils mapped as "eroded" and the rough phases of the "Dissected Plateau Complex", and "Hillwash complex".

4) Gravelly: These are coarse-textured soils with high gravel content (50%). The soils of the shallow-to-gravel range site is underlain by gravel at approximately 40 cm or less. They are associated with glacial outwash or stream-eroded till. An example is Biggar gravelly loam.

5) Saline Upland: Saline upland site is characterized by high content of soluble salts and occurs on nearly level to depressional topography. Soils are poorly drained and weakly developed. Although salt tolerant plants are present in large amounts, many upland species are still important. Salt may appear on soil surface in dry periods.

6) Badlands: This site is characterized by a mosaic of nonvegetated, highly eroded areas and vegetated "islands". The vegetated areas may resemble the normal uplands but are not large enough to map separately. Productivity is extremely low. Examples include the Kildeer and Big Muddy badlands.

Range Sites Receiving Above Average Moisture

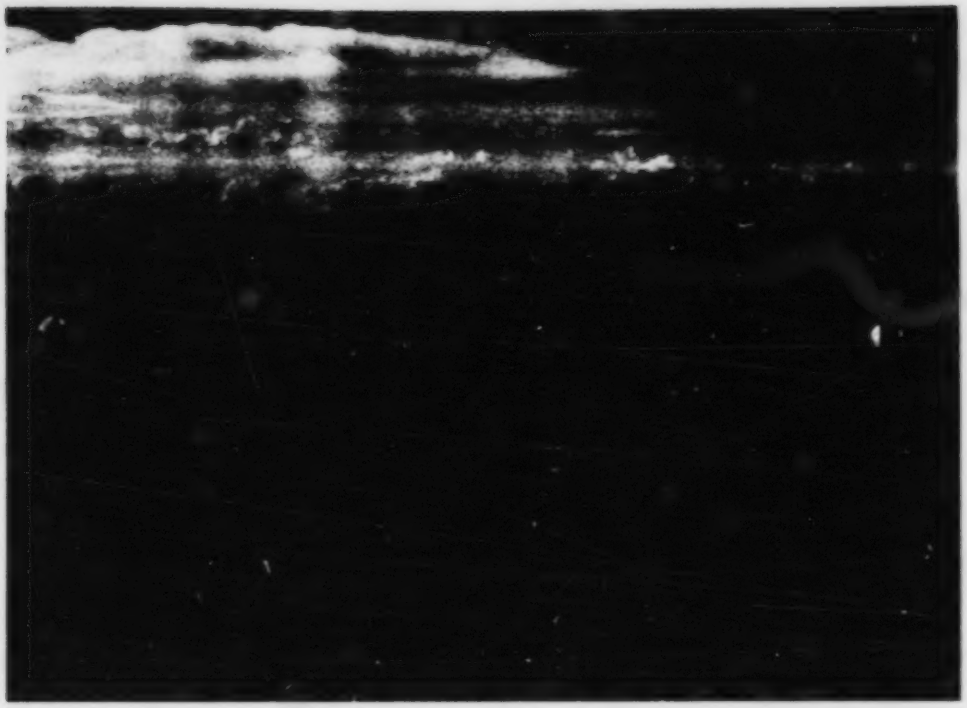
1) Wetlands and Overflow Sites: These are marshy lands with surface water remaining during part of the growing season. Soils are deep but poorly drained and are too wet to cultivate. Subirrigated sites are low-lying wetlands, but usually with no surface water appearing during the growing season. Saskatchewan wetlands show extremely high variability in terms of species composition and productivity.

2) Saline Lowlands: These are poorly drained saline wetlands receiving

A thin upland range site.

additional water from seepage or overflow. Salt tolerant plants supply the bulk of the production.

3) Closed Depression: These are shallow upland depressions and basins which occasionally receive a relatively small amount of runoff. This is usually included in a complex with the dominant upland site due to its small areal extent.



A wetland range site dominated by Hairy Sedge. Wetland range sites are generally highly productive.

STOCKING RATES

General

Grazing capacity is the *average* number of grazing animals that can graze the range year after year without damaging the vegetation or soils. Land assessment is often based on grazing capacity.

Stocking rate is the actual number of animals or animal units on a specific range area or field for a specific period of time. Stocking rates vary from year to year due to the fluctuations in forage supply which is mainly due to variability in the amount and seasonal distribution of precipitation. Stocking rate may be expressed as units of area per AU or animal units per unit area. Stocking rates should not be confused with animal or stock density. The latter is the number of animals per unit area (animal-to-land ratio) at a particular instant of time.

Selection of the proper stocking rate is the most important step in planning for grazing management. It affects forage production, forage quality, animal performance, the health of the range and the financial returns from the ranch operation.

Proper stocking when employed together with the other grazing management principles would:

1) ensure uniform use over all the range.
2) provide a residual or unused growth (carryover) that has a considerable value in regaining plant vigor, in protecting the soil, in protecting the plant in severe winters, in restoring soil fertility, in trapping snow, and in providing an emergency feed.
3) Improved animal conditions which could result in greater calving or lambing and in higher prices.
4) Reduce animal losses.

Setting Stocking Rates

As indicated in an earlier section, stocking rate depends on many factors. Because of the variations caused by these factors, an initial stocking rate is determined on the basis of the best available information and then it is revised as experience is gained with the particular range in question. Furthermore, year-to-year adjustments may be necessary depending on current season's growing conditions.

Unfortunately, there is no standardized method for determining proper

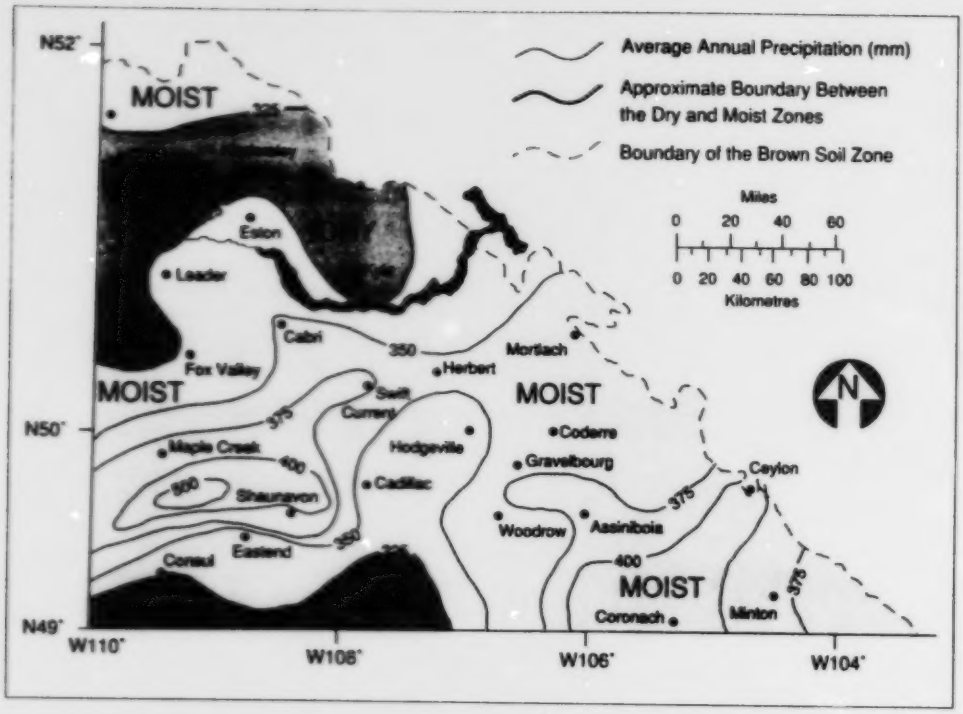


Fig. 8. Moisture regime in the brown soil zone. (Adapted from Environment Canada Report No. CSS - R89-02, 1989)

stocking rates. Usually, initial stocking rates are determined on the basis of one or more of the following approaches:

1) Available guides and published stocking rates.
2) Experience of other ranches with similar range sites.
3) An estimate of the average annual forage yield from clipping data.
4) An estimate of the average annual forage yield data calculated from the average annual precipitation.

One of the common methods employed in determining initial stocking rate for a specific range is based on yield information. In this method forage is clipped at a height of about one inch above the soil surface in a defined area, say 1 m x 1 m. Only current year's growth is clipped. Dead material from previous years should be removed. You may need to repeat this in several areas to obtain a representative sample of the field or range site. Also, you need to repeat sampling for several years to account for interseasonal variability. The material should be air-dried and then weighed. An average yield is calculated and converted into pounds per acre (see conversion table). The average yield is then multiplied by a proper use factor (generally accepted as 55% for most native rangeland) to obtain usable forage. For example, if average yield is 600 lb/acre, usable forage will be 330 lb/acre (600 x 0.55). Stocking rate in animal unit month (AUM) per acre can then be calculated (available forage/780, or 330/780=0.42 AUM/acre). This assumes 780 lb as the amount of forage required by a 1000 lb cow for a month.

Using the Stocking Rate Guide

To determine stocking rate using the guide (Appendix A) developed in this study, follow the steps described below:

1) Determine the soil zone in which the area of concern is located. Note the Brown Soil zone is divided into moist and dry subzones (Figure 8).
2) Identify the range site by examining the soils map and referring to the guide relating the soil units to range sites (Appendix B).
3) Determine the kind of vegetation (i.e., aspen, grassland). This can be determined from air photos or photo maps.
4) Determine range condition as explained in the next section.

Section	Site	Condition	Acres	Recommended Stocking Rates AUM/acre	AUM
4	Clayey	Poor	640	0.23	147
5	Clayey	Poor	590	0.23	136
	Loamy	Fair	50	0.29	15
6	Clayey	Poor	30	0.23	6
	Loamy	Fair	400	0.29	116
7	Loamy	Excellent	640	0.45	288
8	Clayey	Fair	280	0.29	81
	Loamy	Good	360	0.36	130
9	Clayey	Poor	610	0.23	140
	Loamy	Fair	30	0.29	9
16	Clayey	Fair	50	0.29	15
	Loamy	Good	590	0.36	212
17	Loamy	Excellent	640	0.45	288
18	Loamy	Excellent	640	0.45	288
Crested Wheatgrass			200	0.65	130
				Total	2001
				AU/5 month	400

Table 8.
Calculation of initial stocking rates (Dark brown soil)

5) Find the recommended initial stocking rate for the range site and range condition class from the appropriate stocking rate table (Appendix A).
6) Total number of animal units (AUMs) for a particular field or site can then be calculated: area in acres x initial stocking rate AUM/acre (Table 8).
7) Apply appropriate utilization cuts if necessary due to such factors as slope (Table 9) or distance to water (Table 10). The remaining AUM's are considered available for grazing.
8) To convert the AUMs (step 5) to animal-months, use the animal unit equivalent guide provided earlier.

If more than one range site or vegetation type is present, determine the areal extent of each using soil and photo maps. Calculate the AUMs for each range condition class in each range site as explained above. The summation of these values give the total AUMs for the field or ranching unit.

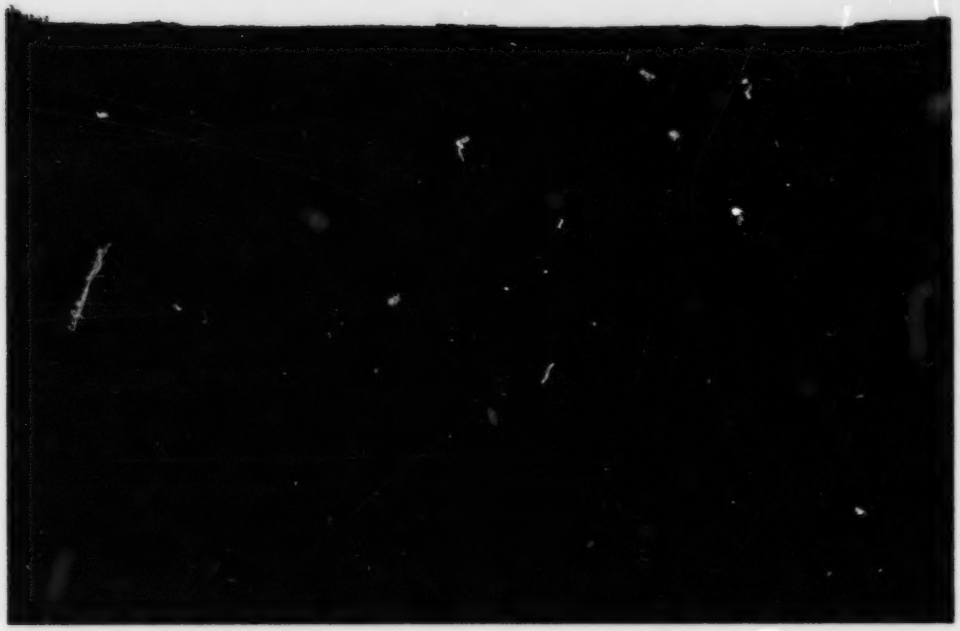
It should be noted that the recommended stocking rates indicated in this publication assume continuous summer grazing. Higher stocking rates are possible when adopting specialized grazing systems or grazing during the dormant season. The potential increase in grazing capacity would vary depending on range condition, the grazing system used, range site, and present grazing management practices.

% Slope	% Reduction in Stocking (cuts)
0-10	None
11-30	30
31-60	60
Over 60	100

Table 9.
Suggested utilization cuts due to degree of slope.

Distance		% Reduction in Stocking
Miles	Kilometres	(cuts)
0-1	0-1.6	None
1-2	1.6-3.2	50
>2	>3.2	100

Table 10.
Suggested utilization cuts due to distance from water.



Different vegetation types (such as grassland and wooded areas shown) vary in their grazing capacity, and therefore, must be considered separately in range analysis.

RANGE CONDITION

General

Since rangelands are subject to various modifications and disturbances, it is important to determine the present state of vegetation and soil of a range site. Range condition relates the present state of the range to a specific benchmark or reference point, usually the natural potential or "climax" vegetation. The term "range condition" should not be confused with seasonal conditions, which may be wet or dry but do not alter the intrinsic "condition" or health of the range.

The concept of range condition discussed here is based on the response of different range plants to continued heavy grazing. The plant species of rangeland may be grouped into the following main categories on the basis of their response to grazing (Figure 9):

1) **Decreasers:** those are plants that decrease in relative importance as a result of continued heavy grazing.
2) **Increasers:** those are plants that increase in relative importance when subjected to continued heavy grazing pressures. Usually increasers start declining after a certain period of time. Some increasers, such as fringed sage, continue to increase with heavy grazing.
3) **Invaders:** those are plants that are not considered as part of the natural vegetation cover, but appear and increase as heavy grazing weakens the native plants.

The range condition classification places the range on a scale between two reference points varying in the proportion of the different plant groups. The highest point is often represented by the "climax" for the specific range site (left side of Figure 9). This highest point is characterized largely by the dominance of decreasers but may contain (Figure 9) a certain amount of increasers. It is assumed that this state provides the highest productivity and greatest ecological stability and is in balance with the prevailing environmental conditions. The other extreme point is represented by a denuded (degraded) area (right side of Figure 9). The latter case describes an area that has lost almost all its original vegetation and with vegetation cover that has been reduced substantially. Such area is usually characterized by "weedy" vegetation or invaders.

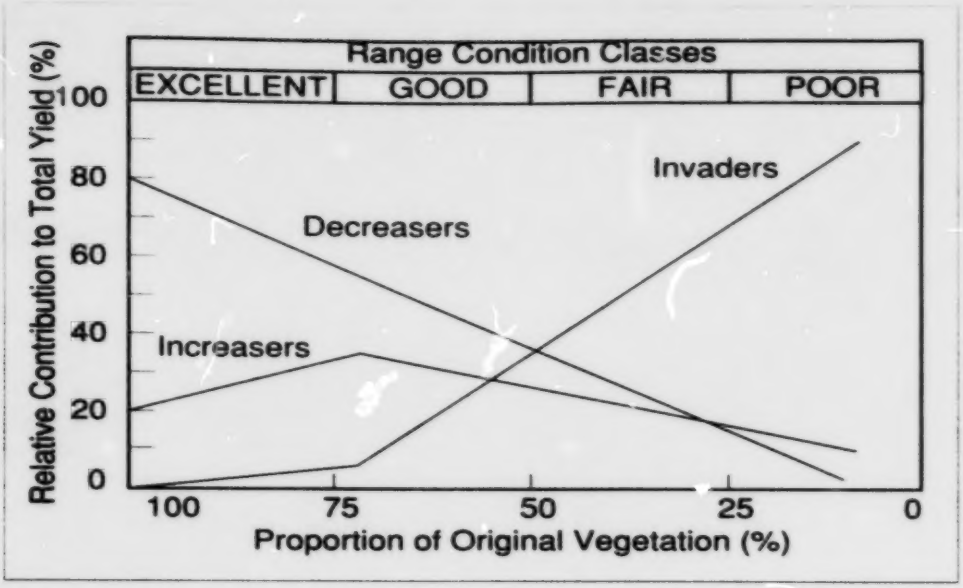


Fig. 9. *Response of range plants to continued heavy grazing pressures.*

The range condition scale described above is arbitrarily divided into four classes:

1) **excellent** range condition with original vegetation contributing more than 75% of the total yield;

2) **good** range condition with original vegetation comprising between 50% and 75% of the total yield;

3) **fair** range condition with original vegetation contributing between 25% and 50% of the total yield; and

4) **poor** range condition where original vegetation represents less than 25% of the total yield.

The change in range condition described above has important implications with respect to the management of the range. Such change is usually accompanied by a substantial reduction in the quantity (Figure 10) and quality of forage produced. Decreasers are the most valuable species because they yield the most forage in relation to the area of soil they occupy. Increasers are lower growing and often less palatable species. Furthermore, the increaser and invader categories include some poisonous plants. Therefore, a reduction in range condition necessitates a reduction in stocking rates, or application of other grazing (Figure 10) management measures, in order to balance forage production and provide for range recovery or improvement.

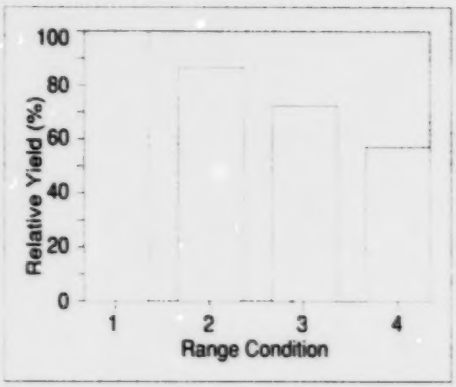


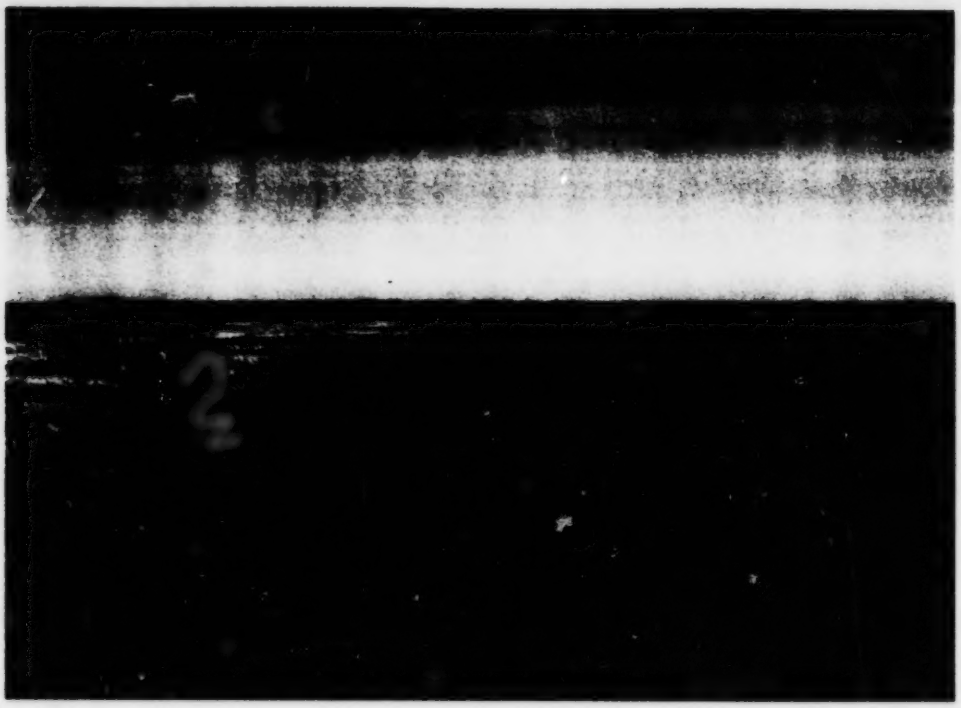
Fig. 10. *Relationship between range condition and relative yield (Based on data from different range sites in the brown and dark brown soil zones).*

Application of the range condition classification in determining appropriate stocking rates have resulted in substantial range improvement over many millions of acres of rangeland in the United States and elsewhere.

The main Saskatchewan range plants have been classified according to their response to grazing (decreasers, increasers and invaders) on the basis of available literature and the experience of the author (Appendix C).

Range Condition Evaluation Methods

One of the common methods used in determining range condition is based on species composition by weight. Composition by weight means the proportions of



Range condition affects the make-up of the plant community and the productivity of the range. The range to the left is in excellent range condition, while the one to the right is in fair range condition and produces less than 50% of the former.

Soil Zone: Brown (Hatton sandy loam) Site: Sandy		
Plant Species	**Actual Composition By Weight (%)**	**Climax or Desirable Plants (%)****
Needle-and-thread	15	15
Blue grama	35	10
Western wheatgrass	5	5
June grass	10	5
Upland sedges	5	5
Fringed sage	30	5
	100	45 = Fair Condition

* See text for explanation.
** Allowable percentage from guide.

Table 11.
Range condition calculations: Example I.*

the different species present on a weight basis. Because actual weight is a laborious technique, weight estimate is often used. For beginners a combination of actual weight and estimated weight is desirable.

Initial range condition surveys should be carried out for each range site within each field. Future surveys may be restricted to **key areas** (or indicator areas) in each range unit or field. A key area should meet the following criteria:

1) accessible to livestock grazing;
2) provide a significant amount of forage; and
3) located away (e.g., 100 m) from such features as watering points and fences.

The range condition classification described here is applicable mainly to grasslands. In certain regions, such as the Gray Soil Zone, the climax plant community is aspen woodland which is not the most suitable community for grazing. Early successional species are more productive. However, plant indicators, for example decreasers, are still useful in assessing grazing pressures in such communities (Appendix C).

Although the technique described here is the best available for Saskatchewan grasslands at the present time, it is generally agreed that it requires improvement through acquiring more field data. Also, development of new techniques should be considered.

Steps in Determining Range Condition

1) Determine and map vegetation types and range sites as explained earlier.
2) Select the key area(s). For initial surveys, a thorough coverage may be necessary. Subsequent surveys could be restricted to key areas.

An upland range site in the black soil zone supports Fescue prairie (left: fair range condition; right: excellent range condition).

3) Using a small sampling frame, for example 0.5m x 0.5m, estimate the percentage contributed by each of the main species (or species composition) to the total yield within that frame*. The form shown in Appendix D can be used for recording the information and subsequent calculations.

4) Calculate range condition rating and determine range condition class according to the following scale:

a) Excellent	76-100%
b) Good	51-75%
c) Fair	26-50%
d) Poor	<26%

To arrive at a range condition rating, the proportions contributed by the decreasers are totalled and included in the range condition score. The values for the invaders, on the other hand, are excluded completely from the calculations. In the case of the increasers, only the maximum climax proportions are included. The maximum climax proportions for the various range sites in the different soil zones are given in Appendix E. Tables 11 and 12 show examples of range condition calculations.

Range condition classes should be indicated on the range inventory map or on an overlay (Figure 6).

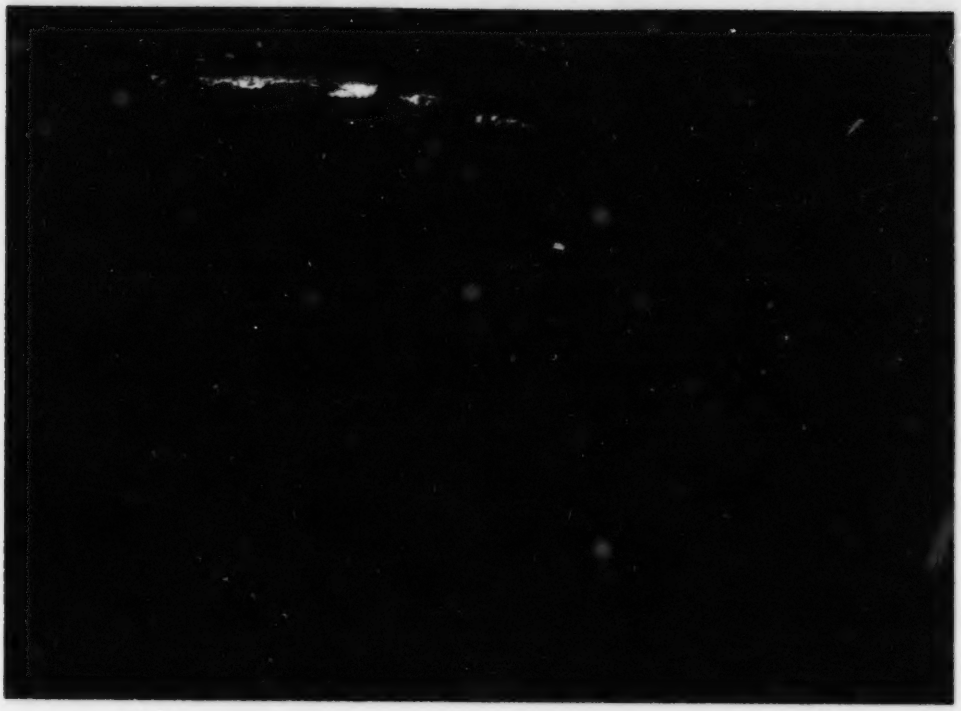
Soil Zone: Black (Oxbow loam)
Site: Loamy

Plant Species	Actual Composition By Weight (%)	Climax or Desirable Plants (%)**
Rough fescue	30	30
Western porcupine grass	5	5
Western wheatgrass	5	5
Green needlegrass	5	5
Weedy forbs	10	5
Shrubby cinquefoil	15	0
Western snowberry	20	5
Sedges	10	5
	100	60 = Good Condition

* See text for explanation.
** Allowable percentage from guide.

Table 12.
Range condition calculations: Example II.*

* For managers doing range evaluation for the first time, it is desirable to first harvest several frames to estimate species composition by actual weight (use air-dry weights). Prior to harvest, make an estimate of the species composition in the same frames. Then, use the actual weight information to calibrate your weight estimates.



A normal upland range site on alluvial deposits in the brown soil zone. Range condition is classified as good.

A SIMPLIFIED GUIDE TO RANGE CONDITION

Under certain circumstances, such as reconnaissance surveys, a simplified system for evaluating range condition may be useful. One such system is described here **for normal upland range sites**. In this system, a satisfactory condition is roughly equivalent to excellent condition rating (75% or greater). An unsatisfactory condition is an intermediate rating which is roughly equivalent to good condition; indicating a moderate degree of range condition deterioration. The highly unsatisfactory condition is equivalent to condition ratings below good (i.e., fair or poor), indicating that a more detailed survey is justified and that drastic changes in grazing management are likely needed.

1) BROWN SOIL ZONE

Coarse-textured Soils:

Satisfactory: the main midgrasses (needle-and-thread, western porcupine grass, wheatgrasses) contribute more than 50% of the total yield. No signs of accelerated soil erosion.

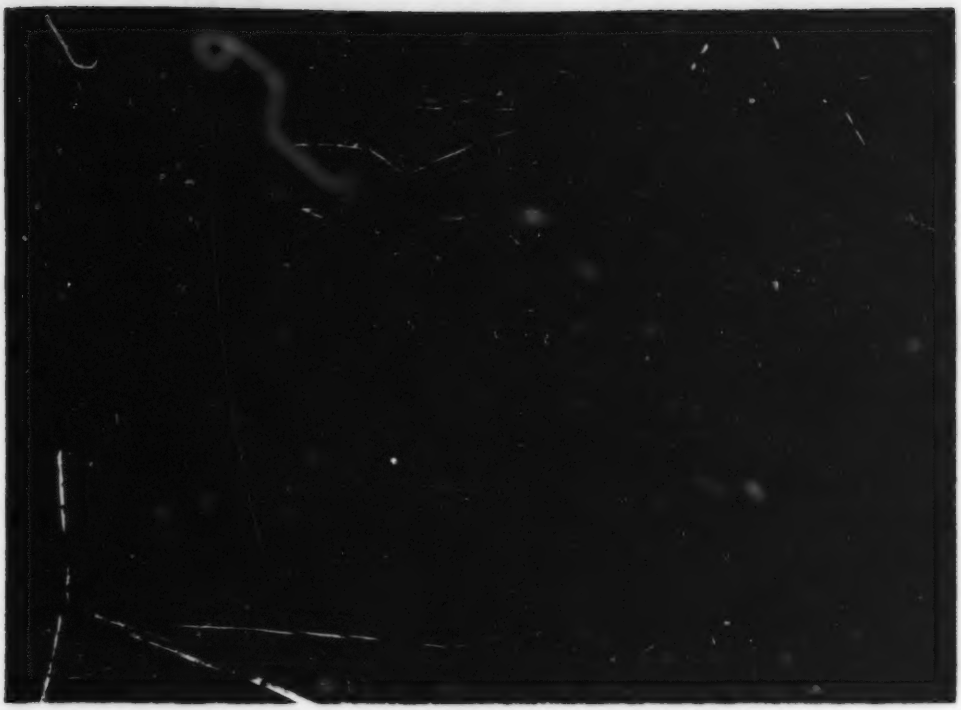
Unsatisfactory: the range is in unsatisfactory condition if any of the following situations are observed:

1) the contribution of blue grama to the total yield exceeds 30%;
2) the contribution of pasture sage exceeds 20%;
3) the contribution of upland sedges exceeds 30%;
4) woody plants contribute more than 30% to the yield;
5) total forb contribution exceeds 30%;
6) extensive livestock trailing and signs of soil erosion are evident.

Highly Unsatisfactory: If two or more of the preceding criteria are met; or if the main midgrasses contribute less than 30% of the yield.

Medium and Fine-textured Soils

Satisfactory: the main midgrasses (northern wheatgrass, western wheatgrass and western porcupine grass) contribute more than 60% of the total yield. Needle-and-thread is included as a desir-



Overgrazing results in a decline in plant vigor and density as shown on this range in the brown soil zone.

able midgrass in the drier portion of this soil zone. No signs of accelerated soil erosion.

Unsatisfactory: the range is in unsatisfactory condition when any of the following criteria is met:

1) the contribution of blue grama to the total yield exceeds 25%;
2) the contribution of pasture sage exceeds 20%;
3) the contribution of upland sedges exceeds 30%;
4) woody plants contribute more than 20% to the yield;
5) total forb contribution exceeds 25%;
6) extensive livestock trailing and signs of soil erosion are evident.

Highly Unsatisfactory: If two or more of the preceding criteria are met; or if the main midgrasses contribute less than 35% of the yield.

2) DARK-BROWN SOIL ZONE

Coarse-textured Soils:

Satisfactory: the main midgrasses (needle-and-thread, western porcupine grass, wheat grasses) contribute more than 55% of the total yield, provided that needle-and-thread does not exceed one third of that. No signs of accelerated soil erosion.

Unsatisfactory: the range is in unsatisfactory condition if any of the following situations are observed:

1) the contribution of blue grama to the total yield exceeds 25%;
2) the contribution of pasture sage exceeds 20%;
3) the contribution of upland sedges exceeds 30%;
4) woody plants contribute more than 30% to the yield;
5) total forb contribution exceeds 25%;
6) the contribution of Kentucky bluegrass exceeds 30%; or
7) extensive livestock trailing and signs of soil erosion are evident.

Highly Unsatisfactory: If two or more of the preceding criteria are met; or if the main midgrasses contribute less than 35% of the yield.

Medium and Fine-textured Soils

Satisfactory: the main midgrasses (northern wheatgrass, western porcu-

pine grass, rough fescue) contribute more than 60% of the total yield. However, the contribution of western wheatgrass should not exceed 30% of total yield. No signs of accelerated soil erosion.

Unsatisfactory: the range is in unsatisfactory condition when any of the following criteria is met:

1) the contribution of blue grama to the total yield exceeds 20%;
2) the contribution of pasture sage exceeds 20%;
3) the contribution of upland sedges exceeds 30%;
4) woody plants contribute more than 25% to the yield;
5) total forb contribution exceeds 30%;
6) the contribution of Kentucky bluegrass exceeds 30%;
7) extensive livestock trailing and signs of soil erosion are evident.

Highly Unsatisfactory: If two or more of the preceding criteria are met; or if the main midgrasses contribute less than 35% of the yield.

3) BLACK SOIL ZONE

Coarse-textured Soils:

Satisfactory: the range is in satisfactory condition when the main midgrasses (rough fescue, green needlegrass, western porcupine grass, and northern wheatgrass) contributes at least 60% of the total yield. No signs of accelerated soil erosion.

Unsatisfactory: the range is in unsatisfactory condition if any of the following situations are observed:

1) the contribution of blue grama to the total yield exceeds 20%;
2) the contribution of Kentucky bluegrass exceeds 25%;
3) the contribution of pasture sage exceeds 20%;
4) the contribution of upland sedges exceeds 30%;
5) woody plants contribute more than 35% to the yield;
6) total forb contribution exceeds 30%;
7) extensive livestock trailing and signs of soil erosion are evident.

Highly Unsatisfactory: If two or more of the preceding criteria are met; or if the main midgrasses contribute less than 35% of the yield.

Medium and Fine-textured Soils

Satisfactory: the range is in satisfactory condition when rough fescue contribute at least 60% of the total yield. No signs of accelerated soil erosion.

Unsatisfactory: the range is in unsatisfactory condition when any of the following criteria is met:

1) the contribution of blue grama to the total yield exceeds 20%;
2) the contribution of Kentucky bluegrass exceeds 25%;
3) the contribution of pasture sage exceeds 20%;
4) the contribution of upland sedges exceed 30%;
5) woody plants contribute more than 30% to the yield;
6) total forb contribution exceeds 30%; or
7) extensive livestock trailing and signs of soil erosion are evident.

Highly Unsatisfactory: If two or more of the preceding criteria are met; or if rough fescue contributes less than 35% of the yield.

Closely used mixed prairie range.

RANGELAND MONITORING

A rangeland monitoring program should be developed and implemented as part of the range plan. The primary goal is to ensure maintenance or improvement of the range. A comprehensive monitoring program should include the following two components.

1) Trend in range condition; and
2) Forage utilization.

Trend in Range Condition

Determining range site and condition is an essential first step in proper range evaluation. However, we need another measure to tell us what is happening to the range with time after this initial assessment and after implementing the various rangeland management and improvement measures. This is called **trend analysis**, or rangeland monitoring. The purpose of range trend analysis is to detect the direction of change in the conditions of vegetation and soil. Therefore, it provides an assessment of the appropriateness of the current management practices and thus help in determining whether any changes in management are necessary.

Two main approaches are used in trend analysis:

1) apparent trend which is based on an assessment, at one point in time, of a number of parameters that reflect apparent changes in range condition; and
2) measured trend, requiring resurveying of a defined location over a number of years.

In order to reduce the cost of trend analysis, the surveyors may focus on key species or indicator species. Key species are the most important species on the range. Usually two to four species are used. The key species are used as indicators because they usually furnish the bulk of the foliage. It is often recommended that a key species should contribute at least 20% of the available forage. This concept is also used in connection with utilization estimates.

Factors that are commonly used to evaluate apparent trend in vegetation condition are:

1) Reproduction of desirable plant species
2) Reproduction of undesirable plant species

Example of areas differing in range condition. The area to the left represents a mixed prairie range in the upper good range condition class, while the area across the fence is a typical example of areas in the fair range condition class.

3) Browse condition
4) Vigour of key species

Factors that are commonly used to evaluate apparent trend in soil condition include:

1) Amount of litter
2) Signs of accelerated erosion
3) Rodent activities

One of the most important parameters used to determine (or measure) trend is basal vegetation cover by species. This is usually done by repeated measurement of basal cover intercept along permanently established transects. Also, point frame or point step methods may be used to measure trend. In the last two cases the surveyor looks at a specific number of points that are randomly located. The number of points that hit plants near their base are related to the total number of points to obtain cover. Litter cover and bare ground can also be estimated from the same survey. Contact your rangeland specialist for more information about rangeland monitoring.

Range Forage Utilization Measurement

Range utilization is the degree to which animals have consumed the total current production of a range area. It is expressed in percentage by weight. Utilization measurement is not a goal in itself. Rather, it is a tool employed to ensure maintenance or improvement of range and livestock productivity. Utilization measurements provide the basis for grazing pressure adjustments during the grazing season.

Although there are many methods devised to measure utilization, there are no sufficient data to adapt most of them for use in Saskatchewan rangeland. The weight comparison method, though laborious, is the most accurate. In this method, the weight of grazed plants in key areas is compared with that of ungrazed plants. Movable cages are used to protect plants from grazing. The weight estimate method is also used but requires initial training.

A thin upland range site.

GRAZING DISTRIBUTION

The causes of improper grazing distribution have already been discussed. The solution to distribution problems will vary depending on the causative factors. There are many measures that can be used to improve grazing distribution in rangeland as explained below.

Fencing

New cross fences may be needed to correct grazing distribution problems, particularly those related to field size, landscape or site characteristics, or vegetation differences. A common problem in Saskatchewan is that rangeland fences often follow section lines. While this may be satisfactory in nearly level rangeland, it will create grazing distribution problems in areas of varied topography or vegetation. Therefore, for better animal distribution it is desirable to separate different range sites and different vegetation types when possible.

There is a growing use of electric fences on rangeland. In addition to their use to improve distribution, they can be used as temporary barriers for special purposes such as protection of newly seeded areas. Electric fences are relatively inexpensive because posts are widely spaced and the single wire can be easily installed.

In some cases, grazing distribution may be improved by simple measures such as changing the location of a gate, or changing the location of supplemental feeding. Animals tend to establish certain patterns of movement and stick to them, unless certain management changes are introduced.

Water Locations

Proper spacing of stock watering facilities is another important method used to aid in improving distribution. It is most effective when used in conjunction with spacing of salt locations.

Grazing animals can travel great distances for water. It should be remembered, however, that travel time and distance take away from grazing and resting time. Energy spent in excessive travel may tax the production of the animal. Excessive travel may further result in the increase in the length and depth of livestock trails. This may expose soil surface to erosion by wind or water.

Topographic characteristics of rangeland exerts a profound effect on the water spacing requirements. The following maximum travel distances are suggested for cattle:

* for rough country: 0.5 mile (0.8 km)
* for rolling, hilly terrain: 0.75 mile (1.2 km)
* for smooth flat terrain: 1.5 miles (2.4 km)
* for nearly level sandy areas: 1.25 miles (2.0 km)
* undulating and dunes: 0.75 miles (1.2 km)

Other Techniques

Other tools that are used to improve animal distribution on the range include:

1) Construction of livestock **trails** and roads over rocky areas, across steep slopes, through dense wood, and across other barriers.
2) Placing the amount of **salt** required by the livestock in the proper location. Locations for salting should be selected so the animals are drawn away from overgrazed or heavily trampled areas. Common salting problems include:
   a) placing salt on bottomland which is already highly frequented by livestock in most rangeland areas of the province;
   b) placing salt in grassy openings in the parkland and other wooded regions instead of locating them in the bush areas to encourage their utilization;
   c) placing too much salt in one place;
   d) locating salt closer than 400 m from water;
   e) locating salt over 1.6 km apart;
   f) placing salt in the same location year after year; and
   g) not guiding the animals to the new locations.
3) Herding
4) Burning of lightly grazed areas would encourage their use by livestock
5) Fertilization of lightly used areas would attract grazing animals
6) Use of a combination of any of the above depending on the particular conditions of the ranch

Improving animal distribution will be reflected in a reduction in the nonrange feed requirements and in an increase in the weight of animal products.

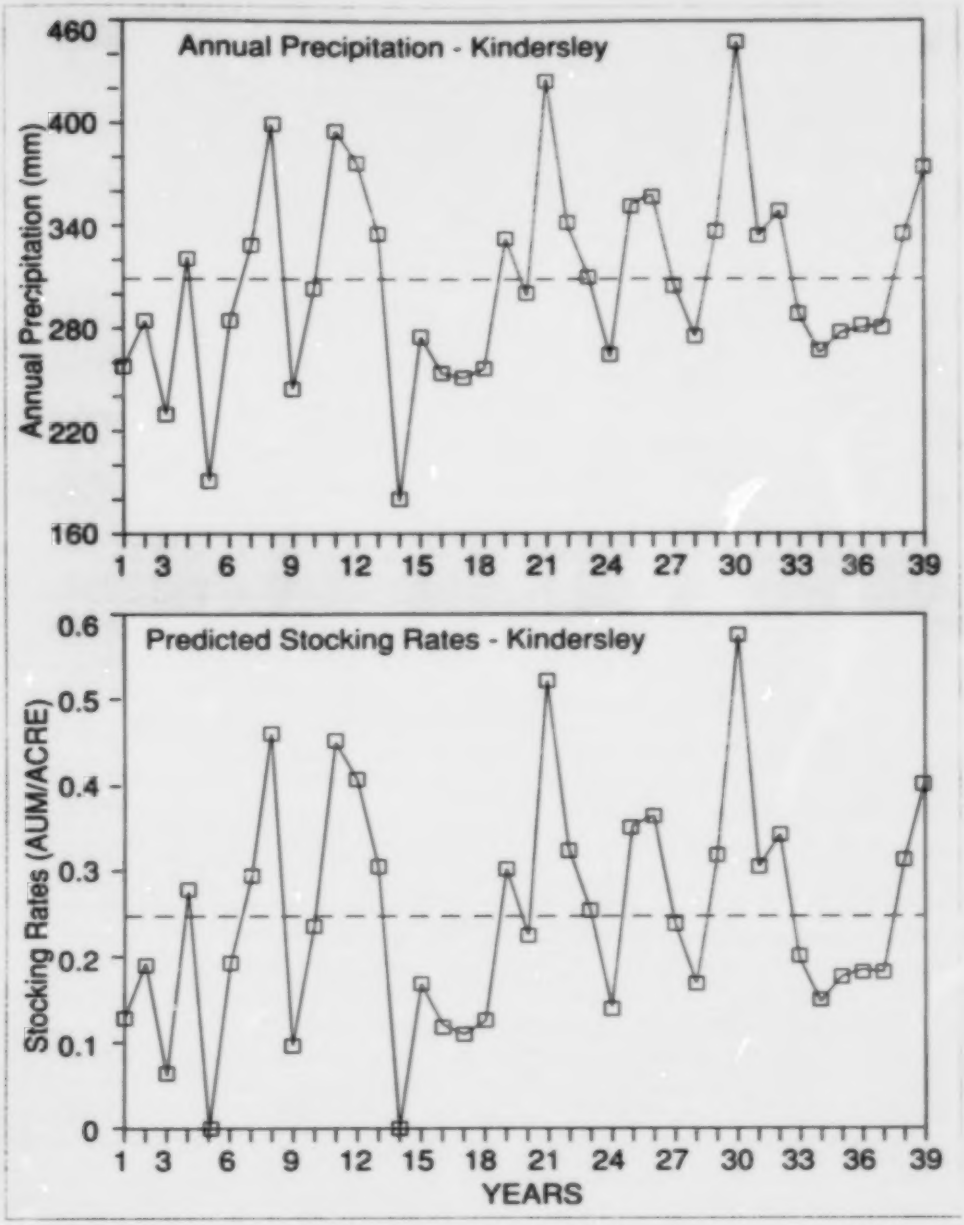


Fig. 11. *Pattern of annual precipitation for Kindersley over a 39 year-period (Dashed line represents average precipitation). (Based on data provided by Environment Canada, Regina)*

Fig. 12. *Annual stocking rate calculated from precipitation data (Fig. 11) for a 39 year-period. (Dashed line represents average stocking rate.)*

COPING WITH DROUGHT

Rangeland forage production fluctuates greatly from one year to another mainly as a result of the variability in precipitation (Figure 11). This means a correspondir.g fluctuations in the possible stocking rates (Figure 12). This creates difficulties for the range managers, particularly in cow-calf operations. In high rainfall years, forage production is high but the rancher often cannot take full advantage of the abundant forage. However, drought is of greater concern to the operator.

Drought cannot be controlled but its impact can be moderated by proper livestock management. It should be remembered that the rate of vegetative recovery from drought depends greatly on the pre-drought range condition or health of the range. Ranges originally in good to excellent condition recover much more rapidly than ranges in poor to fair range condition. It is, therefore, essential to

A mixed prairie range in a poor range condition. Original vegetation was Needlegrass-Wheatgrass community.

keep your range in at least good condition. This can be achieved by implementing a properly prepared range plan that is based on the principles of grazing management and by periodically monitoring range condition. In other words, effective preparation for drought starts long before drought strikes (advance planning).

Even with conservative stocking based on average production, shortages of forage can be expected in more than 50% of the years (Figure 12). A desirable policy is to limit the cow-calf herd to only 80% of the recommended stocking rate. The remaining 20% may be covered by yearlings, a readily marketable class of stock. This will provide some degree of flexibility and will restrict the need for supplemental feeding largely to periods of severe drought. (Figure 11 and Figure 12) When a dry year or phase of the weather cycle begins, do not delay long in reducing the stocking rate. The sooner the number of animals is reduced, the smaller the reduction will need to be.

Accumulate feed reserves, such as hay and silage, during favourable years well beyond current needs, so that feed will be available in dry years. In this way, it may be possible to reduce the grazing pressure on land that is regularly grazed by grazing hay fields rather than cutting them.

Grazing pressure on rangeland can be lessened by using seeded pastures in spring and fall. Emphasis should be placed on the proper selection of seeding sites and adapted species (see list of suggested readings).

Advance planning for drought should also be tied to an appropriate livestock and forage (such as hay) marketing strategy. Such strategy will utilize the possibility of using different kinds or classes of animals. Culling regularly is a desirable policy.

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APPENDIX A
Stocking Rate Guide

(The guides provided here are based on the presently available information. Further refinement may be necessary as more information becomes available in the future.)

Table A.1.
Recommended stocking rates (AUM/acre) for the dry areas in the Brown Soil Zone.

Range Sites	Range Condition			
	Excellent	Good	Fair	Poor
Clayey	0.25	0.20	0.16	0.13
Loamy	0.25	0.20	0.16	0.13
Sandy	0.20	0.16	0.13	0.10
Sand	0.20	0.16	0.13	0.10
Dune sand	0.15	0.12	0.10	0.08
Burnout	0.15	0.12	0.10	0.08
Saline upland	0.15	0.12	0.10	0.08
Closed depression	0.40	0.32	0.25	0.21
Thin	0.15	0.12	0.10	0.08
Badland	0.08	0.06	0.05	0.04
Gravelly	0.15	0.12	0.10	0.08
Shallow-to-gravel	0.15	0.12	0.10	0.08
Limy	0.15	0.12	0.10	0.08
Saline lowland	0.25	0.20	0.16	0.13
Wetland	0.60	0.48	0.38	0.30

Table A.2.
Recommended Stocking Rates (AUM/acre) for the Moist Areas in the Brown Soil Zone.

Range sites	Range Condition			
	Excellent	Good	Fair	Poor
Clayey	0.35	0.28	0.22	0.17
Loamy	0.35	0.28	0.22	0.17
Sandy	0.30	0.24	0.19	0.15
Sand	0.30	0.24	0.19	0.15
Dune sand	0.20	0.16	0.13	0.10
Burnout	0.20	0.16	0.13	0.10
Saline upland	0.20	0.16	0.13	0.10
Closed depression	0.50	0.40	0.32	0.25
Thin	0.20	0.16	0.13	0.10
Badland	0.10	0.08	0.06	0.04
Gravelly	0.20	0.16	0.13	0.10
Shallow-to-gravel	0.20	0.16	0.13	0.10
Limy	0.20	0.16	0.13	0.10
Saline lowland	0.35	0.28	0.22	0.17
Wetland	0.70	0.56	0.45	0.36

Table A.3.
Recommended Stocking Rates (AUM/acre) Guide for the Nonwooded Areas in the Dark Brown Soil Zone.

Range sites	Range Condition			
	Excellent	Good	Fair	Poor
Clayey	0.45	0.36	0.29	0.23
Loamy	0.45	0.36	0.29	0.23
Sandy	0.40	0.32	0.26	0.21
Sand	0.40	0.32	0.26	0.21
Dune sand	0.30	0.24	0.19	0.15
Burnout	0.25	0.20	0.16	0.13
Saline upland	0.25	0.20	0.16	0.13
Closed depression	0.60	0.40	0.32	0.25
Thin	0.25	0.16	0.13	0.10
Badland	0.20	0.08	0.06	0.04
Gravelly	0.25	0.20	0.16	0.13
Shallow-to-gravel	0.25	0.20	0.16	0.13
Limy	0.25	0.20	0.16	0.13
Saline lowland	0.45	0.36	0.29	0.23
Wetland	0.80	0.64	0.51	0.41

Table A.4.
Recommended Stocking Rates (AUM/acre) for Nonwooded Areas in the Black Soil Zone.

Range sites	Range Condition			
	Excellent	Good	Fair	Poor
Clayey	0.55	0.44	0.35	0.28
Loamy	0.55	0.44	0.35	0.28
Sandy	0.45	0.36	0.29	0.23
Sand	0.45	0.36	0.29	0.23
Dune sand	0.30	0.24	0.19	0.15
Burnout	0.30	0.24	0.19	0.15
Saline upland	0.30	0.24	0.19	0.15
Closed depression	0.70	0.56	0.45	0.36
Thin	0.30	0.24	0.19	0.15
Gravelly	0.30	0.24	0.19	0.15
Shallow-to-gravel	0.30	0.24	0.19	0.15
Limy	0.30	0.24	0.19	0.15
Saline lowland	0.55	0.44	0.35	0.28
Wetland	0.90	0.72	0.58	0.46

Table A.5.
Recommended Stocking Rates* (AUM/acre) for Wooded Areas.

Vegetation or Site	Soil Zone			
	Dark Brown	Black	Dark Gray	Gray
ASPEN				
Normal upland	0.10	0.10	0.15	0.15
Dune sand	0.10	0.20	0.15	0.15
Closed depression	0.10	0.20	0.15	0.15
Thin	NA	0.10	0.10	0.10
CLEARED				
Nonseeded	NA	--	0.40	0.40
OTHERS				
Wetland	NA	NA	0.40	0.40

* Rates are for stands in satisfactory conditions. Although formal rating of range condition is not used here, an indication of condition can be obtained from the relative abundance of the decreasers.(see plant list).
NA: not applicable, see the previous two tables.
-- No data or sites are not common.

APPENDIX B:
Range Site Guide

SOIL Zone	SOIL TAXONOMIC UNITS	TEXTURE	RANGE SITE
Black	ALKALI	Variable	Saline lowland (some ponding)
Black	ALKALI	Variable	Saline upland (no ponding)
Black	ALLUVIUM	Variable	Wetland (some ponding)
Black	ALLUVIUM	Variable	Normal upland (no ponding)
Black	BLAINE LAKE CALCAREOUS BLACK	CL	loamy
Black	BLAINE LAKE ORTHIC BLACK	CL, L	loamy
Black	BLAINE LAKE ORTHIC BLACK	FL, VFL	sandy
Black	BLAINE LAKE REGO BLACK	L	loamy
Black	BLAINE LAKE REGO BLACK SALINE PHASE	CL	saline upland
Black	BLAINE LAKE SOLONETZIC BLACK	L	loamy
Black	BONE CREEK ELUVIATED BLACK	SIL	loamy
Black	BONE CREEK ELUVIATED BLACK	SL	sandy
Black	BONE CREEK ORTHIC BLACK	[illegible]L	loamy
Black	BONE CREEK ORTHIC BLACK	[illegible], SL	sandy
Black	CUDWORTH	[illegible], SiL	loamy
Black	CUDWORTH	LL	sandy
Black	CUTKNIFE ORTHIC BLACK	L	loamy
Black	CUTKNIFE ORTHIC BLACK	VL	sandy
Black	CUTKNIFE ORTHIC BLACK SALINE PHASE	SIL, L	saline upland
Black	CUTKNIFE REGO BLACK	FL	sandy
Black	DUNE SAND	S	dune sand (strongly to very strongly rolling)
Black	DUNE SAND	S	Sands (gently to moderately rolling)
Black	EDAM HUMIC REGOSOL	LS	dune sand
Black	EDAM HUMIC REGOSOL	S, LFS	sands
Black	EDAM ORTHIC HUMIC REGOSOL	S, FS	dune sand
Black	EDAM ORTHIC HUMIC REGOSOL	S, LS, FS, LFS	sands
Black	EDAM ORTHIC HUMIC REGOSOL	FS, LS	thin
Black	EDAM ORTHIC REGOSOL	S, FS	dune sand
Black	EDAM ORTHIC REGOSOL	S, FS, LS	thin
Black	ERODED	Variable	thin
Black	FAIRWELL ORTHIC BLACK	L, GL, SIL	loamy
Black	FAIRWELL REGO BLACK	SL	sandy
Black	GRAVEL		gravelly
Black	HAMLIN ORTHIC BLACK	SL, FL, VL	sandy
Black	HILLWASH	Variable	thin
Black	MARSH	Variable	wetland
Black	MAYFAIR CALCAREOUS BLACK	CL	loamy
Black	MAYFAIR CALCAREOUS BLACK	FL	sandy
Black	MAYFAIR ORTHIC BLACK	L, CL	loamy
Black	MAYFAIR ORTHIC BLACK	F[illegible] SL	sandy
Black	MAYFAIR REGO BLACK	[illegible]	loamy
Black	MEADOW	Variable	close depression
Black	MEOTA ORTHIC BLACK	LFS, LS	sands
Black	MEOTA ORTHIC BLACK	FLS, SL, VL, FL	sandy
Black	MEOTA REGO BLACK	LFS	sands
Black	ONION LAKE BLACK SOLODIZED SOLONETZ	SIL	burnout
Black	OXBOW	LL	sandy
Black	OXBOW	CL, L	loamy
Black	RUNWAY	Variable	thin
Black	SALINE	Variable	saline lowland (ponding)
Black	SALINE	Variable	saline upland (no ponding)
Black	SAND	S	sands
Black	SPEERS BLACK SOLODIZED SOLONETZ	LS	burnout
Black	UNDIFFERENTIATED SANDS	S	sands
Black	WHITESAND ORTHIC BLACK	LS	sands
Black	WHITESAND ORTHIC BLACK	SL	sandy
Black	YORKTON	LL	sandy
Black	YORKTON	L, CL	loamy

Appendix B continued...

SOIL Zone	SOIL TAXONOMIC UNITS	TEXTURE	RANGE SITE
Brown	ALKALI	Variable	Saline lowland (ponding)
Brown	ALKALI	Variable	Saline upland (no ponding)
Brown	ALLUVIUM	Variable	Wetland (ponding)
Brown	ALLUVIUM	Variable	Normal upland (no ponding)
Brown	ANTELOPE HUMIC REGOSOL	LS	dune sand
Brown	ANTELOPE HUMIC REGOSOL	S, LS, FL	thin
Brown	ANTELOPE ORTHIC REGOSOL	S	dune sand
Brown	ANTELOPE ORTHIC REGOSOL	S, LS	thin
Brown	ARDILL CALCAREOUS BROWN	L	loamy
Brown	ARDILL ELUVIATED BROWN	CL, L	loamy
Brown	ARDILL GLEYED BROWN	L	closed depression
Brown	ARDILL ORTHIC BROWN	L	loamy
Brown	ARDILL ORTHIC BROWN	CL, L	loamy
Brown	ARDILL REGO BROWN	CL, L	loamy
Brown	ARDILL SOLONETZIC BROWN	C	clayey
Brown	ARDILL SOLONETZIC BROWN	CL, L	loamy
Brown	BIG MUDDY SOILS	C, CL	saline lowland
Brown	BIG MUDDY SOILS	C, CL	wetland
Brown	BIRSAY ORTHIC BROWN	FL, SL	sandy
Brown	BIRSAY ORTHIC BROWN SALINE PHASE	VL	saline upland
Brown	BIRSAY SOLONETZIC BROWN	SL	sandy
Brown	DISSECTED PLATEAU	Variable	badland
Brown	DISSECTED PLATEAU	Variable	thin (strongly to very strongly sloping)
Brown	DISSECTED PLATEAU	Variable	normal upland (gently to moderately sloping)
Brown	DUNE SAND	S	dune sand (strongly to very strongly rolling)
Brown	DUNE SAND	S	sands (gently to moderately rolling)
Brown	EASTEND SOILS	SIC	clayey
Brown	EASTEND SOILS	L, CL	loamy
Brown	ECHO BROWN SOLOD	CL, L	burnout
Brown	ECHO BROWN SOLODIZED SOLONETZ	CL, L	burnout
Brown	ECHO BROWN SOLONETZ	CL,L	burnout
Brown	ERODED	Variable	thin
Brown	EXPOSURE	Variable	badland
Brown	FIFE LAKE	L, CL	loamy
Brown	FIFE LAKE	SL	sandy
Brown	FIFE LAKE	LS	sand
Brown	FOX VALLEY GLEYSOL	SIL	wetland
Brown	FOX VALLEY ORTHIC BROWN	L	loamy
Brown	FOX VALLEY ORTHIC BROWN SALINE PHASE	L	saline upland
Brown	FOX VALLEY REGO BROWN	L	loamy
Brown	FOX VALLEY SOLONETZIC BROWN	L, SIL	loamy
Brown	GRAVEL		gravelly
Brown	HATTON CALCAREOUS BROWN	SL	sandy
Brown	HATTON GLEYED BROWN	LS	sands
Brown	HATTON GLEYED BROWN	FL	sandy
Brown	HATTON GLEYED CALCAREOUS BROWN	SL	sandy
Brown	HATTON ORTHIC BROWN	L	loamy
Brown	HATTON ORTHIC BROWN	LS	sands
Brown	HATTON ORTHIC BROWN	SL, FL, FSL	sandy
Brown	HATTON REGO BROWN	SL	sandy
Brown	HAVERHILL CALCAREOUS BROWN	L	loamy
Brown	HAVERHILL CALCAREOUS BROWN	SL	sandy
Brown	HAVERHILL ELUVIATED BROWN	L	loamy
Brown	HAVERHILL ORTHIC BROWN	L	loamy
Brown	HAVERHILL ORTHIC BROWN	SL, FL	sandy
Brown	HAVERHILL REGO BROWN	L, SCL	loamy
Brown	HAVERHILL REGO BROWN	SL	sandy
Brown	HAVERHILL SOLONETZIC BROWN	L	burnout
Brown	HILLWASH	Variable	thin
Brown	KELSTERN BROWN GLEYED SOLOD	L	burnout
Brown	KELSTERN BROWN SOLOD	CL, L, SIL	burnout
Brown	KELSTERN BROWN SOLODIZED SOLONETZ	L	burnout
Brown	KELSTERN BROWN SOLONETZ	CL, L, SIL	burnout

Appendix B continued...

SOIL Zone	SOIL TAXONOMIC UNITS	TEXTURE	RANGE SITE
Brown	KETTLEHUT BROWN GLEYED SOLODIZED SOLONETZ	C	burnout
Brown	KETTLEHUT BROWN SOLOD	CL, L, SIL	burnout
Brown	KETTLEHUT BROWN SOLODIZED SOLONETZ	C, CL, L, SIL	burnout
Brown	KETTLEHUT BROWN SOLONETZ	CL, L, SIL	burnout
Brown	KETTLEHUT GLEYED BROWN SOLONETZ	C	burnout
Brown	KINDERSLEY BROWN GLEYED SOLODIZED SOLONETZ	CL	burnout
Brown	KINDERSLEY BROWN SOLOD	C	burnout
Brown	KINDERSLEY BROWN SOLODIZED SOLONETZ	C, CL, L	burnout
Brown	KINDERSLEY BROWN SOLONETZ	C	burnout
Brown	MEADOW	Variable	Closed depression
Brown	ROBSART BROWN SOLODIZED SOLONETZ	L	burnout
Brown	ROBSART GLEYED BROWN SOLODIZED SOLONETZ	CL	burnout
Brown	RUNWAY	Variable	thin
Brown	SCEPTRE	HC,C	Clayey
Brown	SALINE	Variable	saline lowland (ponding)
Brown	SALINE	Variable	saline upland (no ponding)
Brown	SAND	S	sands
Brown	SWINTON ORTHIC BROWN SALINE PHASE	L	saline upland
Brown	VALOR ELUVIATED BROWN	L	loamy
Brown	VALOR GLEYED BROWN	SICL, SIL	loamy
Brown	VALOR GLEYED CALCAREOUS BROWN	SIL	loamy
Brown	VALOR GLEYED REGO BROWN	SICL	loamy
Brown	VALOR ORTHIC BROWN	CL, L, SIL	loamy
Brown	VALOR REGO BROWN	CL	loamy
Brown	VALOR SOLONTEZIC BROWN		laomy
Brown	WILLOWS CALCAREOUS BROWN	CL	loamy
Brown	WILLOWS GLEYED BROWN	L	closed depression
Brown	WILLOWS ORTHIC BROWN	C	clayey
Brown	WILLOWS ORTHIC BROWN	CL, L	loamy
Brown	WILLOWS ORTHIC BROWN SALINE PHASE	SIL	saline upland
Brown	WILLOWS REGO BROWN	CL	loamy
Brown	WILLOWS SOLONETZIC BROWN	CL	burnout
Brown	WINGELLO BROWN SOLODIZED SOLONETZ	L	burnout
Brown	WOOD MOUNTAIN	FSL, LL, SCL	sandy
Brown	WOOD MOUNTAIN	L, CL	loamy
Brown	WOOD MOUNTAIN	C	clayey
Dark Brown	ALKALI	Variable	Saline lowland (ponding)
Dark Brown	ALKALI	Variable	Saline upland (no ponding)
Dark Brown	ALLUVIUM	Variable	Wetland (ponding)
Dark Brown	ALLUVIUM	Variable	Normal upland (no ponding)
Dark Brown	AMULET CALCAREOUS DARK BROWN	CL	loamy
Dark Brown	AMULET ELUVIATED DARK BROWN	CL, L, SIL	loamy
Dark Brown	AMULET GLEYED ELUVIATED DARK BROWN	CL	loamy
Dark Brown	AMULET ORTHIC DARK BROWN	CL, L, SIL	loamy
Dark Brown	AMULET SOLONETZIC DARK BROWN	CL, L	loamy
Dark Brown	ASQUITH CALCAREOUS DARK BROWN	SL	sandy
Dark Brown	ASQUITH GLEYED DARK BROWN	LS	wetland
Dark Brown	ASQUITH GLEYED REGO DARK BROWN SALINE PHASE	LS	saline upland
Dark Brown	ASQUITH ORTHIC DARK BROWN	S, FS, LS	sands
Dark Brown	ASQUITH ORTHIC DARK BROWN	FSL, SL	sandy
Dark Brown	ASQUITH REGO DARK BROWN	FSL, SL	sandy
Dark Brown	BIGGAR ORTHIC DARK BROWN	L	loamy
Dark Brown	BIGGAR ORTHIC DARK BROWN	LS	sands
Dark Brown	BIGGAR ORTHIC DARK BROWN	SL, FSL	sandy
Dark Brown	BIGGAR ORTHIC DARK BROWN	GL	shallow-to-gravel
Dark Brown	BRADWELL CALCAREOUS DARK BROWN	L	loamy
Dark Brown	BRADWELL CALCAREOUS DARK BROWN	VL, SL	sandy
Dark Brown	BRADWELL ELUVIATED DARK BROWN	VL	sandy
Dark Brown	BRADWELL ORTHIC DARK BROWN	L	loamy
Dark Brown	BRADWELL ORTHIC DARK BROWN	FS, LS	sands

Appendix B continued...

SOIL Zone	SOIL TAXONOMIC UNITS	TEXTURE	RANGE SITE
Dark Brown	BRADWELL ORTHIC DARK BROWN	FSL, VL, SL, FL	sandy
Dark Brown	BRADWELL REGO DARK BROWN	VL, FL	sandy
Dark Brown	BROOKING DARK BROWN SOLOD	L, CL	burnout
Dark Brown	BROOKING DARK BROWN SOLODIZED SOLONETZ	L, CL	burnout
Dark Brown	CYPRESS ORTHIC DARK BROWN	SIL,L	loamy
Dark Brown	DISSECTED PLATEAU	Variable	thin (strongly to very strongly sloping)
Dark Brown	DISSECTED PLATEAU	Variable	normal upland (genetly to moderately sloping)
Dark Brown	DUNE SAND	S	dune sand (strongly to very strongly rolling)
Dark Brown	DUNE SAND	S	sands (gently to moderately rolling)
Dark Brown	ELSTOW CALCAREOUS DARK BROWN	L, SIL	loamy
Dark Brown	ELSTOW ELUVIATED DARK BROWN	CL	loamy
Dark Brown	ELSTOW ORTHIC DARK BROWN	SIL, L, CL, SICL	loamy
Dark Brown	ELSTOW ORTHIC REGOSOL	SICL	thin
Dark Brown	ELSTOW SOLONETZIC DARK BROWN SALINE PHASE	SIL, SICL	saline upland
Dark Brown	ERODED	Variable	thin
Dark Brown	ESTEVAN DARK BROWN SOLOD	CL	burnout
Dark Brown	ESTEVAN DARK BROWN SOLODIZED SOLONETZ	CL	burnout
Dark Brown	ESTEVAN DARK BROWN SOLONETZ	CL	burnout
Dark Brown	EXPOSURE	Vriable	badland
Dark Brown	GRAVEL		gravelly
Dark Brown	HANLEY DARK BROWN SOLODIZED SOLONETZ	SICL, L, SIL	burnout
Dark Brown	HANLEY DARK BROWN SOLONETZ	CL, SICL	burnout
Dark Brown	HANLEY GLEYED DARK BROWN SOLONETZ	L	burnout
Dark Brown	HILLWASH SOILS	Variable	thin
Dark Brown	JONES CREEK ORTHIC REGOSOL	SL	thin
Dark Brown	MEADOW	Variable	closed depression
Dark Brown	ROSEMAE DARK BROWN SOLODIZED SOLONETZ	L	burnout
Dark Brown	RUNWAY	Variable	thin
Dark Brown	SALINE	Variable	saline lowland (ponding)
Dark Brown	SALINE	Variable	saline upland (no ponding)
Dark Brown	SAND	S	sands
Dark Brown	SCOTSGUARD ORTHIC DARK BROWN	L	loamy
Dark Brown	SCOTT CALCAREOUS DARK BROWN	L	loamy
Dark Brown	SCOTT ORTHIC DARK BROWN	L	loamy
Dark Brown	SCOTT ORTHIC DARK BROWN	VL	sandy
Dark Brown	SCOTT REGO DARK BROWN	L	loamy
Dark Brown	SUTHERLAND REGO DARK BROWN SALINE PHASE		saline upland
Dark Brown	TUXFORD DARK BROWN SOLODIZED SOLONETZ	CL	burnout
Dark Brown	TUXFORD DARK BROWN SOLONETZ	L	burnout
Dark Brown	VERA GLEYED HUMIC REGOSOL	LS, S, SL	thin
Dark Brown	VERA ORTHIC HUMIC REGOSOL	LS, S	dune sand
Dark Brown	VERA ORTHIC HUMIC REGOSOL	LS, S, MS, FS, LFS, SL	thin
Dark Brown	VERA ORTHIC REGOSOL	S, FS, MS	dune sand
Dark Brown	VERA ORTHIC REGOSOL	LS, FS, S	thin
Dark Brown	WEYBURN CALCAREOUS DARK BROWN	L, CL	loamy
Dark Brown	WEYBURN CALCAREOUS DARK BROWN	FS	sands
Dark Brown	WEYBURN CALCAREOUS DARK BROWN	SL	sandy
Dark Brown	WEYBURN ELUVIATED DARK BROWN	L	loamy
Dark Brown	WEYBURN GLEYED DARK BROWN	L	loamy
Dark Brown	WEYBURN GLEYED REGO DARK BROWN	L	loamy
Dark Brown	WEYBURN ORTHIC DARK BROWN	L, CL	loamy
Dark Brown	WEYBURN ORTHIC DARK BROWN	FS, LS	sands
Dark Brown	WEYBURN ORTHIC DARK BROWN	SL, VL, FSL, FL	sandy
Dark Brown	WEYBURN REGO DARK BROWN	L	loamy
Dark Brown	WEYBURN REGO DARK BROWN	FS	sands
Dark Brown	WEYBURN REGO DARK BROWN	L, SL	sandy
Dark Brown	WEYBURN SOLONETZIC DARK BROWN SALINE	L	saline upland
Dark Brown	WYMARK ELUVIATED DARK BROWN	SIL	loamy
Dark Brown	WYMARK ORTHIC DARK BROWN	SIL	loamy
Dark Brown	WYMARK ORTHIC DARK BROWN	FL	sandy

Appendix B continued...

SOIL Zone	SOIL TAXONOMIC UNITS	TEXTURE	RANGE SITE
Dark Gray	ALLUVIUM	Variable	Normal upland (no ponding)
Dark Gray	ALLUVIUM	Variable	Wetland (ponding
Dark Gray	DUNE SAND	S	dune sand (strongly to very strongly rolling)
Dark Gray	DUNE SAND	S	sands (gently to moderately rolling)
Dark Gray	ERODED	Variable	thin
Dark Gray	HILLWASH SOILS	Variable	thin
Dark Gray	KAMSACK ORTHIC DARK GRAY	SIL	loamy
Dark Gray	LORENZO ORTHIC DARK GRAY	L	loamy
Dark Gray	MEADOW	Variable	closed depression
Dark Gray	NISBET ORTHIC DARK GRAY	S, FLS	sands
Dark Gray	NISBET REGO DARK GRAY	LS	sands
Dark Gray	SHELLBROOK ORTHIC DARK GRAY	FL	sandy
Dark Gray	UNDIFFERENTIATED SANDS	S	sands
Dark Gray	WHITEWOOD	LL	sandy
Dark Gray	WHITEWOOD	L, CL	loamy
Gleysol	CATHKIN CHRNOZEMIC SALINE	SL, L	saline upland
Gleysol	CATHKIN GLEYSOLIC SALINE	SL	saline upland
Gleysol	FLAT LAKE SALINE SOILS	L, CL, C	saline upland
Gleysol	GLEYSOLIC SOILS	SICL, C, LS, FS, SIL, L, SL, FL	wetland
Gleysol	GRILL LAKE SALINE SOILS	C, HC	saline lowland
Gleysol	HUMIC GLEYSOL	CL	saline lowland
Gleysol	HUMIC GLEYSOL	L, SIL, CL, SICL	wetland
Gleysol	HUMIC LUVIC GLEYSOL	CL	wetland
Gleysol	LUVIC GLEYSOL	C	wetland
Gleysol	ORTHIC HUMIC GLEYSOL	CL	wetland
Luvisol	ALLUVIUM	Variable	Wetland (ponding)
Luvisol	ALLUVIUM	Variable	Normal upland (no ponding)
Luvisol	DUNE SAND	S	dune sand (strongly to very strongly rolling)
Luvisol	DUNE SAND	S	sands (gently to moderately rolling)
Luvisol	ERODED	Variable	thin
Luvisol	HILLWASH	Variable	thin
Luvisol	MEADOW	Variable	closed depression
Luvisol	MEETING LAKE DARK GRAY LUVISOL	L	loamy
Luvisol	PORCUPINE PLAIN ORTHIC GRAY LUVISOL	L	loamy
Luvisol	SWAN PLAIN ORTHIC GRAY LUVISOL	L	loamy
Luvisol	SYLVANIA DARK GRAY LUVISOL	FL	sandy
Luvisol	UNDIFFERENTIATED SANDS	S	sands
Luvisol	WAITVILLE DARK GRAY LUVISOL	L	loamy
Regosol	SHALE	C	badland
Regosol	HILLWASH SOILS	Variable	thin
Regosol	See Regosols in the various zones		thin

APPENDIX C

Response of Main Saskatchewan Range Plants to Continued Heavy Grazing.

	BROWN	DARK BROWN	BLACK-GRAY
1) GRASSES			
Alkali cord grass	INCREASER	INCREASER	INCREASER
Bearded wheatgrass	DECREASER	DECREASER	DECREASER
Big bluestem	-	DECREASER	DECREASER
Blue grama	INCREASER	INCREASER	INCREASER
Canada reed grass	INCREASER	INCREASER	INCREASER
Canada wildrye	DECREASER	DECREASER	DECREASER
Fowl blue grass	DECREASER	DECREASER	DECREASER
Fowl manna grass	DECREASER	DECREASER	DECREASER
Fringed brome grass	DECREASER	DECREASER	DECREASER
Green needlegrass	DECREASER	DECREASER	DECREASER
Hair grass	INVADER	INVADER	INVADER
Hairy wildrye	-	-	INCREASER
Hooker's oatgrass	DECREASER	DECREASER	DECREASER
Indian rice grass	DECREASER	DECREASER	DECREASER
Intermediate oatgrass	-	INCREASER	INCREASER
June grass	INCREASER	INCREASER	INCREASER
Kentucky bluegrass	INVADER	INVADER	INVADER
Little bluestem	INCREASER	INCREASER	INCREASER
Mat muhly	INCREASER	INCREASER	INCREASER
Narrow reed grass	DECREASER	DECREASER	DECREASER
Needle-and-thread	DECREASER	INCREASER	INCREASER
Northern awnless brome	-	DECREASER	DECREASER
Northern reed grass	DECREASER	DECREASER	DECREASER
Northern wheatgrass	DECREASER	DECREASER	INCREASER
Nuttall Alkali grass	DECREASER	DECREASER	DECREASER
Plains muhly	INCREASER	INCREASER	INCREASER
Plains reed grass	INCREASER	INCREASER	INCREASER
Porcupine grass	-	DECREASER	DECREASER
Prairie dropseed	DECREASER	DECREASER	DECREASER
Purple oat grass	-	DECREASER	DECREASER
Rough fescue	DECREASER	DECREASER	DECREASER
Salt grass	INCREASER	INCREASER	INCREASER
Sand dropseed	DECREASER	DECREASER	DECREASER
Sand grass	INCREASER	INCREASER	INCREASER
Sandberg's bluegrass	INCREASER	INCREASER	INCREASER
Sheep fescue	INCREASER	INCREASER	INCREASER
Side-oats grama	-	DECREASER	DECREASER
Slender wheatgrass	DECREASER	DECREASER	INCREASER
Slough grass	INCREASER	INCREASER	INCREASER
Spangle top	DECREASER	DECREASER	DECREASER
Sweet grass	-	INCREASER	INCREASER
Switch grass	DECREASER	DECREASER	DECREASER
Tall manna grass	DECREASER	DECREASER	DECREASER
Western porcupine grass	DECREASER	DECREASER	INCREASER
Western wheatgrass*	DECR/INCR	DECR/INCR	INCREASER
White-grained rice grass	-	DECREASER	DECREASER
Wild barley	INVADER	INVADER	INVADER
2) GRASSLIKE PLANTS			
Awned sedge	DECREASER	DECREASER	DECREASER
Baltic rush	INCREASER	INCREASER	INCREASER
Beaked sedge	-	DECREASER	DECREASER
Graceful sedge	DECREASER	DECREASER	DECREASER
Low sedge	INCREASERI	NCREASER	INCREASER
Pen or sun-loving sedge	INCREASER	INCREASER	INCREASER
Thread-leaved sedge	INCREASER	INCREASER	INCREASER

Appendix C continued...

	BROWN	DARK BROWN	BLACK-GRAY
3) FORBS			
Beard tongue	INCREASER	INCREASER	INCREASER
Bedstraw	INCREASER	INCREASER	INCREASER
Blazing aster	DECREASER	DECREASER	DECREASER
Broomweed	INVADER	INVADER	INVADER
Cactus	INCREASER	INCREASER	-
Canada thistle	INVADER	INVADER	INVADER
Club moss	INCREASER	INCREASER	INCREASER
Common peppergrass	INVADER	INVADER	INVADER
Cream-colored vetchling	-	DECREASER	DECREASER
Crocus	INCREASER	INCREASER	INCREASER
Dandelion	INVADER	INVADER	INVADER
Death camas	INCREASER	INCREASER	INCREASER
Everlasting	INVADER	INVADER	INVADER
Gaillardia	INCREASER	INCREASER	INCREASER
Goatsbeard	INVADER	INVADER	INVADER
Golden aster	INCREASER	INCREASER	INCREASER
Golden bean	INCREASER	INCREASER	INCREASER
Graceful goldenrod	INCREASER	INCREASER	INCREASER
Gumweed	INVAD/INCR	INVADER	INVADER
Lamb's quarters	INVADER	INVADER	INVADER
Leafy spurge	INVADER	INVADER	INVADER
Locoweeds	INCREASER	INCREASER	INCREASER
Long-headed coneflower	INCREASER	INCREASER	INCREASER
[illegible] goldenrod	INCREASER	INCREASER	INCREASER
Meadow rue	INCREASER	INCREASER	INCREASER
Milkvetches	INCREASER	INCREASER	INCREASER
Moss phlox	INCREASER	INCREASER	INCREASER
Prairie sage	INCREASER	INCREASER	INCREASER
Purple prairie clover	DECREASER	DECREASER	DECREASER
Scarlet mallow	INCREASER	INCREASER	INCREASER
Silky or silvery lupine	INCREASER	INCREASER	INCREASER
Skeleton weed	INCREASER	INCREASER	INCREASER
Smooth aster	INCREASER	INCREASER	INCREASER
Solomon's seal	INCREASER	INCREASER	INCREASER
Sweet-broom	INCREASER	INCREASER	INCREASER
Three-flowered avens	INCREASER	INCREASER	INCREASER
Vetches	DECREASER	DECREASER	DECREASER
White prairie aster	INCREASER	INCREASER	INCREASER
Wild licorice	INCREASER	INCREASER	INCREASER
Wild peavine	-	DECREASER	DECREASER
Woolly yarrow	INCREASER	INCREASER	INCREASER
Yellow avens	INCREASER	INCREASER	INCREASER
4) SHRUBS AND TREES			
Aspen poplar	-	INVAD/INCREAS	INVAD/INCREAS
Chokecherry	DECREASER	DECREASER	DECREASER
Currant	-	-	INCREASER
Fringed sage	INCREASER	INCREASER	INCREASER
Greasewood	INCREASER	INCREASER	-
Green alder	-	-	INCREASER
Low bush-cranberry	-	DECREASER	DECREASER
Nuttall's saltbush	DECREASER	DECREASER	DECREASER
Pin cherry	-	DECREASER	DECREASER
Prairie rose	INCREASER	INCREASER	INCREASER
Prickly rose	INCREASER	INCREASER	INCREASER
Red-osier dogwood	-	DECREASER	DECREASER
Saskatoon	DECREASER	DECREASER	DECREASER
Shrubby cinquefoil	INCREASER	INCREASER	INCREASER
Silver sage	INCREASER	INCREASER	INCREASER
Western snowberry	INCREASER	INCREASER	INCREASER
Willow	INCREASER	INCREASER	INCREASER
Winterfat	DECREASER	DECREASER	DECREASER
Wolfwillow	INCREASER	INCREASER	INCREASER
Wood's rose	INCREASER	INCREASER	INCREASER

* Status varies with range sites

APPENDIX D:

Rangeland Inventory Sheet

Name of Ranching Unit

Date

Field Number | Total Area (acres) | Range Site | Range Site (acres) | Range Type

Soil Zone | Soil Type | Topography

Species	Contribution (%)											Allowable Climax (%)
	1	2	3	4	5	6	7	8	9	10	Average	
Total												

Average Cover (%) | Clubmoss Cover (%) | Bare Ground (%) | Range Condition: Rating (%) | Class

Recommended Stocking Rate (AUM/acre) | Total Animal Unit Months For Site (AUM)

Utilization Cut (%) (AUM) | Initially Adjusted Stocking Rate (AUM)

Management and Improvement Potential

Rangeland Inventory Summary Sheet

Name of Ranching Unit

Date

Total Area (acre) | Soil Zone

Field Number	Range Site	Range Condition	Area (acre)	Stocking Rate		Utilization Cuts		Adjusted Stocking Rate (AUM)
				AUM/acre	AUM	%	AUM	
TOTAL								

APPENDIX E:

Guide To Range Condition Of Grasslands

(This guide provided here is based on the presently available information. Further refinement maybe necessary as more information becomes available in the future.)

Table E1:
Guide to Range Condition of Grasslands in the Brown Soil Zone.

Plant Groups	Maximum contribution (%) to original vegetation (dry-weight basis)													
	Wetland	Sub-irrigated	Over-flow	Saline lowland	Sands	Sandy	Loamy	Clayey	Dune sand	Gravel	Thin uplands	Saline uplands	Burn-outs	Bad-lands
1) INCREASERS														
Needle-and-thread	-	-	10	-	35	25	20	10	30	30	d	d	d	d
Blue grama	-	-	-	-	5	10	5	5	5	5	5	-	20	15
Sandberg's bluegrass	-	-	-	-	-	-	-	5	-	10	10	d	5	d
June grass	-	-	-	-	5	5	5	25	10	10	10	-	10	10
Plains reedgrass	-	-	-	5	-	5	5	-	-	10	d	10	d	-
Sand grass	-	-	-	-	15	10	-	-	15	-	-	-	-	-
Western wheatgrass	-	20	d	d	30	d	d	d	d	d	d	d	d	d
Plains muhly	-	-	-	-	-	-	-	-	-	5	5	5	-	5
Mat muhly	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Salt grass	-	5	-	10	-	-	-	-	-	-	-	25	-	-
Sedge increasers	25	15	5	5	5	5	5	5	5	10	10	-	5	d
Baltic rush	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Western snowberry	-	10	5	-	-	-	5	-	-	-	-	-	-	-
Fringed sage	-	-	-	-	5	5	5	5	5	5	5	5	-	5
Silver sage	-	-	5	-	5	-	-	-	10	5	-	-	-	-
Greasewood	-	-	-	10	-	-	-	-	-	5	5	-	-	d
Other woody increasers	15	10	10	-	10	5	-	5	20	5	5	-	-	5
Forb increasers	5	-	-	-	-	-	5	5	5	5	5	5	5	5

2) DECREASERS

Northern wheatgrass
Green needlegrass
Western porcupine grass
Slender wheatgrass
Rough fescue
Bearded wheatgrass
Indian rice grass
Sand dropseed
Winterfat

3) INVADERS

Wild barley
Gumweed
Dandelion
Lamb's quarters
Goat's beard
Russian thistle
Broomweed
Leafy spurge
All other annuals
All other exotics

d: decreaser

Appendix E continued...

Table E2:
Guide to Range Condition of Grasslands in the Dark Brown Soil Zone.

Plant Groups	Maximum contribution (%) to original vegetation (dry-weight basis)											
	Wetland	Sub-irrigated	Over-flow	Saline lowland	Sands	Sandy	Loamy	Clayey	Dune sand	Gravel	Thin uplands	Saline uplands
1) INCREASERS												
Needle-and-thread	-	-	5	-	20	15	10	10	25	25	d	d
Blue grama	-	-	-	-	-	5	5	5	-	10	10	10
Sandberg's bluegrass	-	-	-	-	-	-	-	5	-	10	10	10
June grass	-	-	-	-	-	-	5	5	10	10	10	-
Plains reedgrass	-	-	-	-	-	-	-	-	-	5	d	-
Sand grass	-	-	-	-	15	15	-	-	20	-	10	-
Western wheatgrass	-	15	30	30	d	d	30	20	d	d	d	d
Plains muhly	-	-	-	-	-	5	-	-	-	5	5	5
Mat muhly	-	5	5	10	-	-	-	-	-	-	-	5
Little bluestem	-	-	-	-	-	-	-	-	-	5	-	-
Sedge increasers	40	20	5	5	5	5	5	-	5	5	10	-
Kentucky bluegrass	5	5	5	-	-	5	5	5	-	-	-	-
Western snowberry	-	-	-	-	5	-	-	5	-	5	-	-
Fringed sage	-	-	-	-	5	5	5	5	-	5	5	-
Silver sage	-	-	5	5	-	-	-	-	10	-	5	-
Woody increasers	10	-	-	-	10	5	5	5	10	-	-	-
Forb increasers	10	-	-	-	-	-	-	5	5	-	5	5

2) DECREASERS		**3) INVADERS**	
Rough fescue	Slender wheatgrass	Wild barley	Canada thistle
Green needlegrass	Northern wheatgrass	Gumweed	Leafy spurge
Western porcupine grass	Bearded wheatgrass	Dandelion	All other annuals
Sideoats grama	Indian Rice grass	Lamb' quarters	All other exotics
Porcupine grass	Sand dropseed	Russian thistle	
Switch grass	Winterfat	Broomweed	

d: decreaser

Table E3:
Guide to Range Condition of Grasslands in the Black Soil Zone.

Plant Groups	Maximum contribution (%) to original vegetation (dry-weight basis)									
	Wetland	Sub-irrigated	Over-flow	Saline lowland	Sands	Sandy	Loamy	Clayey	Gravel	Thin uplands
1) INCREASERS										
Western porcupine grass	-	-	-	-	25	20	10	10	-	-
June grass	-	-	-	-	5	5	5	5	10	10
Wheatgrasses	-	10	25	10	5	5	10	5	d	d
Intermediate oatgrass	-	-	-	-	-	5	5	5	5	5
Plains muhly	-	-	-	-	-	-	-	-	5	5
Salt grass	-	-	-	10	-	-	-	-	-	-
Sedge increasers	20	10	10	5	5	5	5	5	5	5
Shrubby cinquefoil	-	-	-	-	5	-	-	-	10	5
Forb increasers	5	5	5	5	5	5	5	5	5	5
Woody increasers	15	10	10	-	10	5	5	5	5	5

2) DECREASERS	**3) INVADERS**	
Rough fescue	Sheep fescue	Dandelion
Green needlegrass	Wild barley	All other annuals
Slender wheatgrass	Hair grass	All other exotics
Vetches	Kentucky bluegrass	
Hedysarum	Canada thistle	

d: decreaser

Appendix F:
Common and Scientific Names of Some Saskatchewan Range Plants

1) GRASSES

Alkali cord grass	Spartina spp.
Bearded wheatgrass	Agropyron subsecundum
Big bluestem	Andropogon gerardii
Blue grama	Bouteloua gracilis
Canada reed grass	Calamagrostis canadensis
Canada wildrye	Elymus canadensis
Fowl blue grass	Poa palustris
Fowl manna grass	Glyceria striata
Fringed brome grass	Bromus ciliatus
Green needlegrass	Stipa viridula
Hair grass	Agrostis scabra
Hairy wildrye	Elymus innovatus
Hooker's oatgrass	Helictotrichon hookeri
Indian rice grass	Oryzopsis hymenoides
Intermediate oatgrass	Danthonia intermedia
June grass	Koeleria cristata
Kentucky bluegrass	Poa pratensis
Little bluestem	Andropogon scoparius
Mat muhly	Muhlenbergia richardsonis
Narrow reed grass	Calamagrostis neglecta
Needle-and-thread	Stipa comata
Northern awnless brome	Bromus pumpellianus
Northern reed grass	Calamagrostis inexpansa
Northern wheatgrass	Agropyron dasystachyum
Nuttall Alkali grass	Puccinellia nuttalliana
Plains muhly	Muhlenbergia cuspidata
Plains reed grass	Calamagrostis montanensis
Porcupine grass	Stipa spartea
Prairie dropseed	Sporobolus heterolepis
Purple oat grass	Schizachne purpurascens
Rough fescue	Festuca hallii
Salt grass	Distichlis stricta
Sand dropseed	Sporobolus cryptandrus
Sand grass	Calamovilfa longifolia
Sandberg's bluegrass	Poa secunda
Sheep fescue	Festuca ovina
Side-oats grama	Bouteloua curtipendula
Slender wheatgrass	Agropyron trachycaulum
Slough grass	Beckmannia syzigachne
Spangle top	Scolochloa festucacea
Sweet grass	Hierochloe odorata
Switch grass	Panicum virgatum
Tall manna grass	Glyceria grandis
Western porcupine grass	Stipa curtiseta
Western wheatgrass	Agropyron smithii
White-grained rice grass	Oryzopsis asperifolia
Wild barley	Hordeum jubatum

2) GRASSLIKE PLANTS

Awned sedge	Carex atherodes
Baltic rush	Juncus balticus
Beaked sedge	Carex rostrata
Graceful sedge	Carex praegracilis
Low sedge	Carex eleocharis
Pen or sun-loving sedge	Carex pensylvanica
Thread-leaved sedge	Carex filifolia

3) FORBS

Bedstraw	Galium boreale
Blazing aster	Liatris punctata
Broomweed	Gutierrezia sarothrae
Cactus	Opuntia species
Canada thistle	Circium arvense
Club moss	Selaginella densa
Common peppergrass	Lepidium densiflorum
Cream-colored vetchling	Lathyrus ochroleucus
Crocus	Anemone patens
Dandelion	Taraxacum officinale
Death camas	Zygadenus gramineus
Everlasting	Antennaria spp.
Gaillardia	Gaillardia aristida
Goatsbeard	Tragopogon dubius
Golden aster	Chrysopsis villosa
Golden bean	Thermopsis rhombifolia
Graceful goldenrod	Solidago canadensis
Gumweed	Grindelia squarrosa
Horsetails	Equisetum species
Lamb's quarters	Chenopodium album
Leafy spurge	Euphorbia esula
Locoweeds	Oxytropis spp.
Long-headed coneflower	Ratibida columnifera
Low goldenrod	Solidago missouriensis
Meadow rue	Thalictrum venulosum
Milkvetches	Astragalus spp.
Moss phlox	Phlox hoodii
Prairie sage	Artemisa ludoviciana
Purple prairie clover	Petalostemon purpureus
Scarlet mallow	Malvastrum coccineum
Silky or silvery lupine	Lupinus argenteus
Skeleton weed	Lygodesmia juncea
Smooth aster	Aster laevis
Solomon's seal	Smilacina stellata
Sweet-broom	Hedysarum spp
Three-flowered avens	Geum triflorum
Vetches	Vicia spp
White prairie aster	Aster falcatus
Wild licorice	Glycyrrhiza lepidota
Wild peavine	Lathyrus venosus
Woolly yarrow	Achillea lanulosa
Yellow avens	Geum allepicum

4) SHRUBS AND TREES

Aspen poplar	Populus tremuloides
Chokecherry	Prunus virginiana
Fringed sage	Artemisia frigida
Greasewood	Sarcobatus vermiculatus
Nuttall's saltbush	Atriplex nuttallii
Prairie rose	Rosa arkansana
Prickly rose	Rosa acicularis
Saskatoon	Amelanchier alnifolia
Shrubby cinquefoil	Potentilla fruticosa
Silver sage	Artemisia cana
Western snowberry	Symphoricarpos occidentalis
Willow	Salix spp.
Winterfat	Eurotia lanata
Wolfwillow	Elaeagnus commutata
Wood's rose	Rosa woodsii

Conversion Factors for Metric System

Imperial units	Approximate conversion factor	Results in:	
LINEAR			
inch	x 25	millimetre	(mm)
foot	x 30	centimetre	(cm)
yard	x 0.9	metre	(m)
mile	x 1.6	kilometre	(km)
AREA			
square inch	x 6.5	square centimetre	(cm^2)
square foot	x 0.09	square metre	(m^2)
acre	x 0.40	hectare	(ha)
VOLUME			
cubic inch	x 16	cubic centimetre	(cm^3)
cubic foot	x 28	cubic decimetre	(dm^3)
cubic yard	x 0.8	cubic metre	(m^3)
fluid ounce	x 28	millilitre	(ml)
pint	x 0.57	litre	(L)
quart	x 1.1	litre	(L)
gallon	x 4.5	litre	(L)
bushel	x 0.36	hectolitre	(hl)
WEIGHT			
ounce	x 28	gram	(g)
pound	x 0.45	kilogram	(kg)
short ton (2000 lb)	x 0.9	tonne	(t)
TEMPERATURE			
degrees Fahrenheit	(°F-32) x 0.56 or (°F-32) x 5/9	degrees Celsius	(°C)
PRESSURE			
pounds per square inch	x 6.9	kilopascal	(kPa)
POWER			
horsepower	x 746	watt	(W)
	x 0.75	kilowatt	(kW)
SPEED			
feet per second	x 0.30	metres per second	(m/s)
miles per hour	x 1.6	kilometres per hour	(km/h)
AGRICULTURE			
gallons per acre	x 11.23	litres per hectare	(L/ha)
quarts per acre	x 2.8	litres per hectare	(L/ha)
pints per acre	x 1.4	litres per hectare	(L/ha)
fluid ounces per acre	x 70	millilitres per hectare	(ml/ha)
tons per acre	x 2.24	tonnes per hectare	(t/ha)
pounds per acre	x 1.12	kilograms per hectare	(kg/ha)
ounces per acre	x 70	grams per hectare	(g/ha)
plants per acre	x 2.47	plants per hectare	(plants/ha)